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# THESIS

ESTIMATED EFFECTS OF RETIREMENT REVISION  
ON RETENTION OF NAVY  
TACTICAL PILOTS

by

John H. Singley

December 1986

Thesis Advisor

R. A. Weitzman

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Estimated Effects of Retirement Revision on Retention of Navy  
Tactical Pilots

by

John H. Singley  
Lieutenant, United States Navy  
B.S., University of South Carolina, 1974

Submitted in partial fulfillment of the  
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

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## ABSTRACT

Recent changes in military retirement will reduce benefits to members entering service after July 31, 1986. These changes may have effects on Navy tactical pilot retention. This thesis seeks to measure retention effects resulting from retirement revision. A binary-response logistic-regression model was applied to cross-sectional data obtained from randomly selected Navy tactical aviators to evaluate possible determinants of their retention choice behavior. This data analysis suggests that the Military Retirement Act of 1986 will contribute to a decrease in retention rates. Job security, tastes for military life, airline hiring rates, spouse employment, and pay were also found to be significantly (1%) correlated with retention.

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## I. INTRODUCTION AND BACKGROUND

### A. THE PROBLEM

In 1986, the United States Congress passed and President Reagan signed Public Law 99-348, the Military Retirement Act of 1986. The act effectively reduces retired pay of people who enter service after July 31, 1986, by more than 22 percent. This change may have an adverse impact upon retention.

The United States Navy aviation community has experienced difficulty in the past in retaining adequate numbers of trained tactical air pilots<sup>1</sup> beyond their minimum service requirement. The result has been shortages of pilots in mid-career grades. These shortages have financial and readiness costs associated with them.

The new retirement law may cause Navy tactical pilot retention rates to drop to unacceptable levels in terms of Naval aviation force objectives. This result would have serious implications for manpower planning, resource allocation, and Naval air readiness.

### B. BACKGROUND

Public Law 99-348, the Military Retirement Act of 1986 had its seminal beginnings on September 30, 1976, when Democratic Congressman Les Aspin of Wisconsin took the floor of the United States House of Representatives and remarked:

I am today introducing a package of bills designed to reform and refine the whole system of military compensation. The first (bill) concerns pay and allowances . . . The second bill involves military pension reform. This legislation provides that no one who has performed his twenty years can be cast out into the streets and penury. At the same time we will not be blithely mailing huge pension checks to relatively young men who have gone on to well paying jobs. [Ref. 1]

Congressman Aspin's remarks foreshadowed a determined effort on his part to "reform" the military retirement system. His efforts were largely unsuccessful until 1984 when the Democratic House caucus voted to remove Congressman Melvin Price of Illinois as Chairman of the House Armed Services Committee. Aspin was voted to succeed Price as Chairman and it was from this forum that the Representative from

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<sup>1</sup>Tactical aircraft are attack and fighter jets operated principally from aircraft carriers.

Wisconsin took legislative steps that would culminate in Public Law 99-348, the Military Retirement Act of 1986.

To fully understand the importance of this change in benefits, it is necessary to understand how and why the system evolved. The best vantage point for this understanding is through historical context.

## 1. History of U.S. Military Retirement Pay

### a. English Precedence and Colonial Practice

Early English military pension practice is of particular interest as a precursor of philosophies which influenced legislative action in the American colonies and, later, in the United States.

In 1592, the British parliament passed the first law for the relief of maimed or disabled soldiers. The statute provided for an annual pension to be funded by localities where soldiers were pressed into service. In 1697, England established a pension system for officers that allowed half-pay for retired commissioned members. Officers covered under this system were placed on half-pay, were liable to recall to service in time of war, and were subject to military law.

During the Indian conflicts, English colonialists in America quite naturally followed prevailing practice in England. The General Assembly of the Royal Colony of Virginia voted in 1644 to provide pensions for soldiers disabled while defending the colonies from Indian attacks. Other colonies followed suit and enlarged coverage to include widows and orphans of those killed while in service to the colonies. Generally, pensions were limited to those who were totally unable to provide for themselves while, in some instances, pensions proportionate to the level of disability were awarded.

### b. Revolutionary War Pension Acts

Based on the long practice of England and her colonies, provisions for the military in the newly formed United States took a form quite similar to British usage. During the progress of the Revolutionary War, the Continental Congress passed legislation that dealt with the pension question in two ways. First, half-pay for life was promised to those disabled. Second, half-pay for life was to be granted to officers to be paid, upon their retirement, to all who should serve to the end of the war [Ref. 2: p.19]. Unfortunately, the newly formed Continental Congress did not have the financial means to completely pay or outfit soldiers in the field, let alone retirees. Promissory notes were issued immediately following the war and disbanding of the Army in 1783. Despite this gesture, no provision was made by Congress for payment of principal or interest until 1791 by which time many of the certificates had been sold by needy officers to speculators at a deep discount to their face value.

Thus, the first years of our nation's existence demonstrated attitudes of the Congress toward the question of pensions based on prior Federal military service. There seemed to be general agreement that some form of compensation should be made available to those maimed or disabled during war. However, the reluctance of Congress to fund lifetime half-pay pensions for officers based strictly on service during the war had a political as well as financial underpinning. Opposition to officer pensions after demobilization was, in part, based on fear of creating an aristocracy of retired officers such as existed in European monarchies. A privileged class, it was thought, was not consistent with truly democratic ideals. By 1820, however, with the nation's treasury solvent and tariff-generated revenues producing a surplus, Congress felt compelled to fund retirement pensions at halfpay for surviving officers who had served during the Revolutionary War.

By the early nineteenth century two distinct concepts had been established which were later to become part of the modern United States military retirement law: disability pensions to war veterans and retirement pensions based on service alone.

### *c. The Civil War Period*

On August 3, 1862, President Lincoln signed legislation regarded as the first universal retirement law for all services. This Civil War law constitutes the legislative base of the current Uniformed Services Retirement System. It was designed to provide for retirement of Regular<sup>2</sup> Army, Navy, and Marine Corps officers who had engaged in military service as a life's work and who had become unfit for active field duty. Provisions for retirement of enlisted personnel on this basis was not enacted until a later date. The purpose of this law was to increase the efficiency of the professional officer corps by removing those who had become unable to actively carry out their duties, particularly in the field and at sea. It was common for officers to serve until eighty years of age or older. Many of these senior officers were unable to function effectively in the field and were placed on leave or furlough with pay when their units were engaged in campaigns. Under this new law, officers who retired were to receive seventy-five percent of active duty pay, continued subject to trial by courts-martial, and remained subject to active duty recall upon the President's discretion. Similar provisions have been retained in permanent law to the present.

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<sup>2</sup>There are two types of Armed service in the United States: regular and reserve. Regular service is in standing units. Reserve service is in units that train on a part-time basis but are subject to mobilization when required.

Civil War demobilization resulted in the establishment by Congress in 1870 of two more fundamental tenets of current law. The first permitted voluntary retirement of officers after thirty years of service upon approval by the President and the second fixed retired pay at 75 percent of the officer's grade.

The first non-disability retirement law for Marine Corps and Army enlistees was established in 1885. Much like the officer's law, it had provisions for thirty year retirement at 75 percent of base pay with supplemental allowances in lieu of food and quarters. Interestingly, Navy enlistees were excluded until 1899, at which time they were brought under the law. The initial exclusion of Navy enlistees resulted from political bickering arising over the Navy internal pension fund's abundant coffers.

(1) *The Navy Internal Pension Fund.* The Navy pension fund had its origin in measures taken by the Continental Congress in 1775, which specified that a portion of prize proceeds taken by Navy ships be used to pay disability benefits to Navy officers and seamen and death benefits to widows and orphans of Navymen who died in service. With ever an eye toward economy, Congress required that any benefits received by seamen from Federal disability pensions be offset by benefits attributable to the Navy fund.

As might be expected, the size of the Navy fund tended to rise during wars as prize volume increased and decline between wars as increased benefits were distributed to Navy war veterans and survivors. Due to a decreasing flow of prize money resulting from the changing nature of war at sea, the income from Navy pension fund investments had become inadequate by 1880 to satisfy benefit entitlements of Navy and Marine personnel. By 1914, annual Navy pension costs approximated \$ 6 million and only about \$350,000 of that cost was borne by the pension fund (Ref. 2: p.54). The difference was provided from the Federal treasury.

#### *d. The World War I Period*

By the middle of World War I, both the Navy and Army were experiencing a promotion stagnation problem. The presence of older and often infirmed officers was to have been reduced by Civil War era legislation designed to "weed out" older, less efficient officers by allowing for voluntary retirement with pay. Unfortunately, Congress refused to fund the law. The vehicle used for fiscal circumvention was a legislative constraint placed on the numbers of officers who could be carried on retirement rolls. Many officers who applied for retirement were frequently turned down. Thus, while making legal provisions for voluntary retirement, Congress generally did

not permit it. By 1914, problems of an older, inefficient officer corps continued to plague the services.

Congress and the Navy took the lead in attacking the stagnation problem. On August 29, 1919, Congress passed an act that was to be the forerunner of modern officer personnel management. The act established for the first time in permanent law the principle of promotion of the best qualified officers of the Navy. Selection boards were mandated for promotion to Lieutenant Commander through Admiral. Those who failed to select by a certain age were placed on the retired list. Officers involuntarily retired received 2.5 percent of base pay per year of service, not to exceed 75 percent. This new law reflected an increasing awareness of the need for an adequate flow of promotions to assure vigor and vitality within the officer corps of the Navy. Congress recognized the interdependence between promotion systems and retirement law and acted to integrate the two.

Retirement pay computation provisions of the Act of August 29, 1916 incorporated a basic formula which has remained a part of the Uniformed Services Retirement System. This law recognized the concept of retired pay related to length of service as well as grade, using the 2.5 percent times years of service times retired grade formula.

#### *e. Between the World Wars*

Between World War I and World War II both the Army and the Navy continued to experience promotion stagnation problems. By 1935, a 'bulge' existed in the O-4, O-5, and O-6 ranks which resulted from large numbers of reserve officers entering service during World War I and subsequently augmented<sup>3</sup> into the Regular force. By 1940, it was predicted, the average age of Army Colonels would be sixty-two [Ref. 3]. With hostilities imminent, clearly a need existed to vitalize the officer corps. Vigorous and alert leadership would be needed if the military were to undertake rapid development of the force.

The Act of June 23, 1938 made substantial changes in the Navy's promotion and retirement laws. Both age-in-grade and service-in-grade were abandoned. Provision was made for O-3's and O-4's twice failing to select for promotion to be honorably discharged with severance pay equal to two years base pay. Captains not selected for promotion by the time they had served thirty years, Commanders

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<sup>3</sup>Augmentation is the process where a reserve officer is given permanent status as a Regular officer.

completing twenty-eight years, and Lieutenant Commanders who had been continued and completing twenty-six years, would be retired. Promotion selection boards were given authority to recommend unsatisfactory officers for discharge from service. For the first time, this act provided for the voluntary retirement of Regular officers on completion of twenty years of active commissioned service, upon their own application. These were sweeping changes, but necessary, Congress felt, to ensure a youthful, vital Navy officer corps. Many fundamental precepts of this act have been carried forward into current law. [Ref. 4]

*f. The Post World War II Period*

World War II had demonstrated the need for a youthful, vigorous force. To ensure this vitality and to create an effective promotion system, an elimination and a voluntary/involuntary retirement procedure had to be developed. Importantly, it was felt, such a system should protect the interests and entitlements of the individual service member. With this criterion in mind, Congress passed the Officer Personnel Act of August 7, 1947. This law established a permanent promotion system for the Regular armed forces and changed the Army and Air Force systems of promotion by seniority to a selection board system much like that of the Navy. Significantly, the act sought to force attrition in higher ranks as a means of removing older officers and bringing the most capable younger officers along to higher rank at an earlier age. These were the lessons of a hard-fought war; a conflict which taxed the stamina of many of our senior military officers. This legislation fixed by law for the first time the number of officers who might serve in any one grade and prescribed the maximum number of years an officer could be retained on active duty in a specified grade. For nearly thirty-three years, the Officer Personnel Act of 1947 was the legal authority for officer promotions and involuntary retirement systems for the armed forces.

*g. The Advent of DOPMA*

After experience with the force management provisions of the Act of 1947 and recognizing that officers in different branches of service were treated differently, Congress acted to provide uniform retirement authority. The Defense Officer Personnel Management Act of 1980 (DOPMA) made several significant changes. First, tenure was denied for O-4 and O-3 grades who, not being eligible for retirement, are twice passed over in selection for promotion. Provisions were made for continuation of those officers, however, by action of a special board. Second, officers in pay grades O-8, O-7, and O-6 who have at least four years in grade and are not on a list recommended for

promotion along with 0-5's who have twice failed selection may be considered for involuntary retirement by board action. In addition, the act established a three year time-in-grade requirement for voluntary retirement [Ref. 5]. This act is seen as further strengthening the hand of force planners in an effort by Congress to maintain a youthful, more capable force.

## **2. History of Post Retirement Adjustment of Retired Pay**

The foregoing narrative of how the United States military retirement system evolved tends to illustrate the forces that shaped the current system. The lessons of conflict were clear. A youthful force is needed and the retirement system evolved, partly, as a means to bring that about. Therefore, the present retirement system is only partially a pension; it serves also as a force management tool.

There is a second dimension to the military retirement debate: to what extent should retiree pay be protected against a rising cost-of-living? To place that question in proper perspective, it is necessary to examine its history.

### *a. The Early Years*

From 1861 to 1958, increases in retired pay were directly linked to active duty pay increases. If active duty pay rose a certain percentage, retired pay rose an equal amount at the same time. That practice was discontinued with the Act of May 1958 (public law 85-422) when Congress realized that a single 6 percent cost of living increase would cost only \$35 million, as opposed to \$65 million for linking the retired pay to active duty pay.

With the passage of the Uniformed Services Pay Act of 1963 (public law 88-132), adjustments in retired pay of members of the armed services were tied directly to changes in the Consumer Price Index. The retired pay adjustment formula of 1963 was altered by the Act of August 21, 1965 (public law 89-132). The new mechanism granted cost-of-living increases whenever the Consumer Price Index rose more than 3 percent and remained at that level for more than three months. The benefit increase was equal to the percentage rise in the Consumer Price Index. [Ref. 6]

### *b. The Later Years: 1970 to 1985*

Liberalization of cost-of-living adjustments (COLA) reached a nadir in October 1976, when Congress amended the law to allow for COLA payments twice yearly. This had the effect of increasing the rate of compounded growth in retirement annuities. For example, a 5 percent increase granted once a year is an annual effective rate of 5.00 percent. However, a 2.5 percent increase granted twice yearly is an annual effective rate of 5.063 percent.

From 1973 to 1981, COLA increases for retirement pay exceeded active duty pay increases (see Figure 1.1). This produced two noticeable effects. First, active duty officers began retiring when eligible at much higher rates than previous. Second, Congress recognized the inequity and took action to slow growth in retirement COLAS. In August 1981, Public Law 97-35 reduced the payment of retired pay COLAS to once a year.

Further steps were taken by Congress in April 1984, to slow the growth of retirement COLAs. The new law permanently altered existing legislation by changing the way benefits were calculated. The net effect was to reduce the COLA percentage below the Consumer Price Index. Ultimately, the 1984 COLA payment was eliminated entirely.

In 1985, the passage of the Deficit Reduction and Fiscal Responsibility Act (popularly known as Gramm-Rudman-Hollings) struck a further blow to retired pay COLAs by eliminating the 1985 payment.

## PAY INCREASE COMPARISON 1974-81

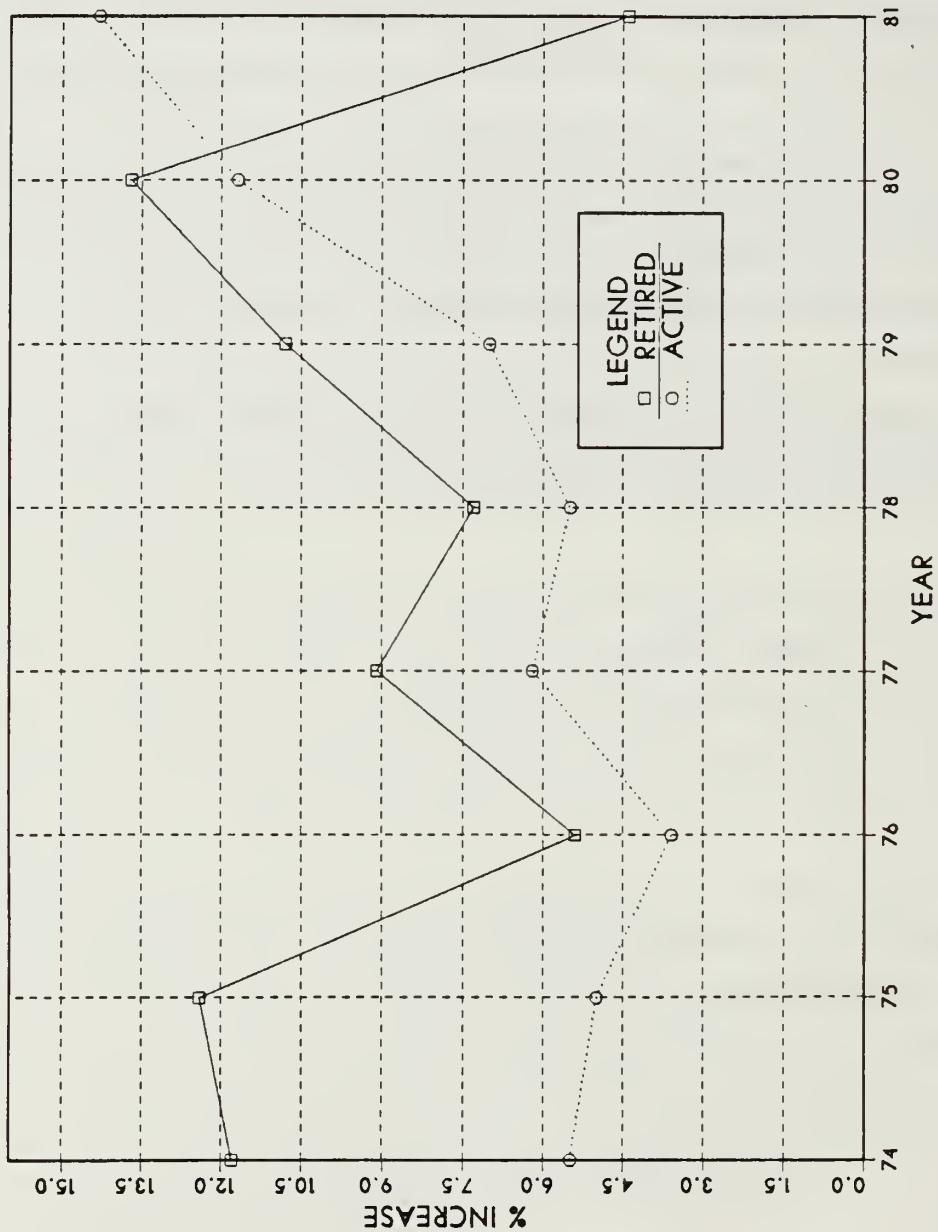


Figure 1.1 Comparison of Retired vs Active Pay Increase: 1974 to 1981.

## **II. LITERATURE SEARCH**

The volume of published research in military manpower issues is increasing. This increase may be at least partly due to the maturing of the all-volunteer-force (AVF). Until the AVF was created, the United States relied exclusively on conscription for armed forces manpower. In terms of personnel costs, conscription is thought to be a lower cost alternative to a standing volunteer force. As wage (and price) levels rose in the decade since the beginning of the AVF, military pay was increased principally as a means to compete in the labor market. Growth in the military pay portion of the Defense budget has created considerable debate over the affordability of an AVF. Increasing emphasis has been placed on achieving better economical use of manpower dollars. This dialogue has given impetus to more rigorous analysis of military retention issues. Researchers have attempted to model individual choice behavior and, by doing so, hope to better understand behavioral effects of policy initiatives.

Four studies have emerged from the plethora of retention research that appear to be useful here: Gotz and McCall [Ref. 7], Warner [Ref. 8], Slackman [Ref. 9], and Gotz and McCall [Ref. 10].

### **A. THE ISSUE OF MONETARY VS. NON-MONETARY FACTORS**

The studies mentioned previously are characterized by their development of behavioral retention models. Such an approach has strong economic foundations, for the primary objective of retention analysis must focus on incentive effects of alternative courses of action. For example, one might wish to determine the net impact of a specific change in compensation policy on force structure. Basic economic assumptions underly such analysis. The most straightforward example is recognition of the service member as a rational actor who seeks to maximize his expected utility. The studies reviewed in this thesis all incorporate this logic set in their models. However, experience tells us monetary return is not always the primary motivation in an individual retention decision. Acknowledgement must be given to the role non-monetary factors play. Importantly, the effects of such variables must be estimated with greater accuracy. The exclusion of non-pecuniary factors from the cited studies has been shown to diminish the explanatory power of their models.

A primary non-monetary factor is an individual's taste for military life. A person's attitude toward the military lifestyle may be a factor in an individual stay or leave decision. Therefore, at a given decision point, those with greater tastes for the service are more likely to stay. As the cohort ages the percentage of individuals with higher tastes increases. It is widely observed that retention rates increase as years-of-service (YOS) increases. It is reasonable to conclude from this relationship that individuals with higher tastes have a higher probability of staying. Self-selection is a process where individuals remove themselves from an occupation as a result of their differing affinities to the job's characteristics. Thus, the increase in retention as YOS rises due to self-selection is distinct from any increase in the financial incentive to stay. The models reviewed in this chapter vary in ability to capture the impact of taste on retention. Failure to estimate the separate effects of individual behavior by people with different tastes will create difficulties in estimating retention. In examining the effects of changes in military compensation, retention rates will be underestimated in the earlier years and overestimated in the later years. This is because people with higher tastes are less sensitive to changes in financial incentives.

Another non-pecuniary factor examined in varying degrees by these studies is random shock effects. Random shocks are those events occurring during an officer's career prompting a decision to leave the service despite strong propensities to remain. A common type of random shock would be a job transfer to a location perceived by the service member to be less than desirable. Because the evidence tells us retention probability approaches one as YOS increases, there should be no losses in the senior year groups. But, in fact, there are. Such losses can be attributed to random shocks. Incorporating this variable should enhance a model's predictive power.

## B. THE PVCOL MODEL

The PVCOL, or present value of the cost of leaving, model attempts to predict rational economic behavior by analyzing income streams available to a service member facing a stay or leave decision. The individual has several choices: (1) He can stay in service, retire when eligible, and receive retirement pay; (2) He can stay one more year, resign, and work in the private sector; (3) He can stay "n" more years, resign, and work in the private sector. The person facing the stay or leave decision must analyze the different income streams available from each course of action and make the following

decision: Which alternative maximizes my income? The PVCOL model makes the evaluation by comparing the present value of each income stream. The difference between the present value of income from staying now and that of staying to the next decision point is termed "the present value of the cost of leaving." Put simply, if future financial returns are greater from staying in the military than from leaving, the PVCOL model will predict a "stay" decision.

Several assumptions are made in this model. First, it is assumed that an individual's alternative income streams are known with certainty. Second, an assumption is made that an individual's discount rate is known. These two assumptions are key elements in building the "rational man" model and as such, prevail throughout the four models under review. Such assumptions are liable for criticism on two grounds: perfect knowledge of future income streams and valid determination of an individual's discount rate over time. Gilman [Ref. 11], Cylke [Ref. 12], and Black [Ref. 13] have attempted to determine individual discount rates with varying results. For example, the study by Black estimated an officer's mean discount rate to be 10.3 percent with a 90 percent confidence interval of 8.5 to 12.4 percent. The same research estimated the mean enlisted rate to be 12.5 percent with a 9.8 to 15.0 percent confidence interval [Ref. 13: p.36]. With wide variation evident in empirical studies, it is not particularly persuasive to argue that individual discount rates can be adequately modeled. However, criticism of the PVCOL model on this basis will be left to other writers. This thesis will focus on a more significant problem in the model: omitted variables bias.

The major limitation of the PVCOL model is bias introduced by omitting the taste variable. The average value of an individual's taste for military service, as noted earlier, rises with years of service. The present value of the cost of leaving also rises with years of service. Since both increasing tastes and an increasing cost of leaving lead to higher retention, a positive bias in the cost of leaving estimate could result if tastes are ignored. Therefore, this model is likely to overpredict effects of monetary changes on retention rates.

### C. THE PERCEIVED PAY MODEL

The Perceived Pay model (PPM) results from work done by Slackman [Ref. 9] to improve on PVCOL methodology. The PPM makes a comparison of discounted future

earnings indigenous to alternative courses of action. The PPM differs from the PVCOL model in the manner in which the earnings comparison is made. The PVCOL calculates returns to staying by analyzing the difference between the present value of leaving now and leaving at each of 'n' future years. The PPM uses a weighted average of the present value of staying until each of the future years. The weights are an individual's probability of remaining in the military until each of the future years. Perceived pay is then derived as the quotient using the weighted average as the numerator and the present value of future income from leaving now as the denominator.

The PPM addresses the taste question by developing a mathematical approximation of individual proclivities for military service. The expression represents the cumulative probability of leaving until the time a stay or leave decision must be made. The use of cumulative probability recognizes the average tastes distribution within a cohort.

Retention is estimated using a logistic distribution:

$$r_i = 1/(1 + e^{-(\beta_0 + \beta_1 \chi_i + \beta_2 * \text{cumrt}_i)}) \quad (\text{eqn 2.1})$$

where:

$r_i$  = retention rate at decision point i.  
 $\chi_i$  = perceived pay at decision point i.  
 $\text{cumrt}_i$  = cumulative retention probability at decision point i.  
 $\beta_0, \beta_1, \beta_2$  = parameters to be estimated.

The manner in which random shocks are treated is the major limitation of this model. The PPM incorporates random shocks in the regression equation error term. This requires an assumption that individuals do not integrate the possibility of future random shocks into their current decisions. This assumption suggests that even though military members experience random shocks at various decision points, they behave as if there would be no more random shocks in the future. It is probable that military members do consider future random shocks in their decisions. By not integrating such considerations in the model, significant explanatory power may be lost.

#### D. THE ANNUALIZED COST OF LEAVING MODEL

The annualized cost of leaving model (ACOL) was first described by John Warner (Ref. 8). This model, like the others, seeks to evaluate the effects of changes in compensation on retention. ACOL builds on previous research by incorporating strengths of the PVCOL and PPM models while attempting to overcome their limitations. Similar in theoretical construct to the earlier models, ACOL describes income maximizing, rational economic behavior.

ACOL derives a maximum military-civilian pay differential in much the same manner as the previous models. The significant difference is the method used to compare the value of staying in the military or leaving and taking a civilian job. Both PPM and PVCOL make a comparison of the present value of leaving at each of the future decision points with the returns to staying at each of these future points. ACOL deviates from this methodology and simply derives a cost of leaving which is the maximum military-civilian pay differential from remaining in the service. While both the PPM and PVCOL model's time horizon is the future decision point that yields the greatest differential, ACOL focuses on those future years of service over which an annual cost of leaving is maximized. This cost of leaving is standardized by dividing by the number of years over which ACOL is maximized. For example, let's assume the present value of staying in the service for four years then leaving is \$100,000; for eight years is \$200,000; for sixteen years is \$300,000; for twenty years is \$600,000; and for twenty-four years is \$400,000. The cost of leaving at the end of the first four years is calculated in Figure 2.1 As can be shown in the calculation, the model predicts a person should remain in service until YOS twenty, at which point the annualized cost of leaving is maximized.

ACOL incorporates tastes into the calculus by assigning the taste factor a monetary value. By using this method, ACOL is directed toward those who are on the margin of the stay or leave decision, not those who are taste neutral. Following is an example showing the relation of taste value to the decision to stay or leave.

From Figure 2.1:

Maximum ACOL	=	\$ 31,250 at YOS 20
Value of Indifference	=	0
Taste Value	=	-31,250

	Years of Service			
	8	16	20	24
PV of staying until YOS above	\$200,000	300,000	600,000	400,000
PV of leaving at end of 4 years	100,000	100,000	100,000	100,000
Cost of Leaving (COL)	100,000	200,000	500,000	300,000
Total YOS >4	4	12	16	20
Annualized COL (col/years >4)	25,000	16,667	31,250	15,000

Figure 2.1 ACOL calculation.

The decision rule is:

Taste value > -31,250 = stay

Taste value = -31,250 = indifferent

Taste value < -31,250 = leave

Because ACOL does not allow tastes to be individually observed, proxy measures are necessary to determine the estimated relationship between retention and the monetary value of tastes. It is assumed that tastes in a given cohort are distributed logically. The model parameters thus can be estimated by logistic regression. The equation is:

$$R_i = \frac{1}{1 + e^{(B_0 + B_1 ACOL_i)}} \quad (\text{eqn 2.2})$$

where

$R_i$  = retention rate at decision point i

$ACOL_i$  = annualized cost of leaving at decision point i

$B_0$  and  $B_1$  = estimated parameters

## 1. ACOL limitations

The major limitation with ACOL is its orientation towards only those who are on the margin. While this is a logical construct if the sole purpose is to consider effects of financial incentives, it ignores random shocks. In the earlier discussion of random shocks, it was noted that future unknown events have an influence on retention. A service member with high tastes for the military (not on the margin) may be induced by a negative shock to leave. Therefore, consideration of the effects of random shocks must be integrated into a model to improve its predictability.

A secondary limitation with both ACOL and the other models is the assumption that an individual has knowledge of future income streams. It is difficult to predict the future with any measure of confidence. Further, it is reasonable to assume that service members form expectations about future civilian income rather than calculate actual amounts. Implicit in any expectation is an element of uncertainty. Consequently, ACOL et al make assumptions exact in nature in an uncertain environment.

Estimation of civilian income opportunities is another elusive factor and has been the subject of many studies. Cooper [Ref. 14,15] has done the most extensive analysis. His research suggests that military retirees have higher incomes than non-military retirees. The opposite conclusion was reached by Raduchel et al [Ref. 16] who found that retirees earned substantially less than comparable civilians. Others, including Danzon [Ref. 17] and DeTray [Ref. 18] offer inconclusive evidence. There appears to be no clear consensus as to what the quantitative dimension of post-military civilian earnings may be. Thus, it is unlikely that all service members share the same expectations. The ACOL assumption of constant future income streams in cross-sectional analysis may be flawed.

### a. *The Assumption of Constant Discount Rates Over Time*

Implicit in models that discount future earnings is an interest rate assumption. To demonstrate the significance of the discount rate, the present value formula is illustrated. The formula for present value is derived from the formula for compound interest:

$$S = P(1 + i)^n \quad (\text{eqn 2.3})$$

where

S = compound sum

P = principal amount

i = interest rate

n = number of periods

For example, the future value (S) of amount \$1000 (P) at an annual rate of 10 % (i) for four (n) years is:

From equation 2.3 :

$$S = \$1000(1.10)^4 = \$1,464 \quad (\text{eqn 2.4})$$

Determining the present value of a future amount is the inverse of the compound sum calculation.

From equation 2.3 by manipulation:

$$S = P(1 + i)^n$$

$$P = S\{1/(1+i)^n\} \quad (\text{eqn 2.5})$$

Using equation 2.5 , the present value (P) of \$1464 received four years into the future, with a 10% interest (discount) rate is \$1000 today:

$$P = \$1464\{1/(1+.10)^4\}$$

$$P = \$1464(.683)$$

$$= \$1000$$

The implicit assumption in this calculation is that the annual amounts are reinvested at the same rate. Fremgen [Ref. 19] points out this implication and notes the difficulty in predicting future interest rates. The assumption by ACOL et al of constant discount rates over time injects a bias in their methodology relative to the uncertainty in forecasting future events.

## **E. THE DYNAMIC RETENTION MODEL**

The Dynamic Retention Model (DRM) is associated with work by Gotz and McCall (Ref. 10). It represents a further step in an ongoing evolution of retention modeling. The DRM answers criticism of PPM, PVCOL, and ACOL by incorporating tastes and random shocks into its equation. DRM, unlike ACOL, recognizes that the distribution of tastes varies over years of service rather than remaining constant. By following the distribution of tastes at each year of service, DRM offers a better explanation of why retention rates tend to rise as YOS increases. Further, DRM establishes a connection between retention rates at year  $i$  with pay policies in periods prior to year  $i$ . For example, an increase in compensation at year  $i-1$  will tend to increase retention rates at year  $i$ . The rise in retention, however, will come in part from people who have lower average tastes but are induced by the pay raise to remain in service. Therefore, the average tastes distribution from all who stayed would be lower than if no raise in year  $i-1$  had been offered. DRM is the only model that implicitly incorporates this linkage.

### **1. DRM and Random Shocks**

The Dynamic Retention Model assumes that service members know random shocks may alter their future behavior. DRM models this assumption by integrating the possibility of future random shocks into calculations of a weighted average of staying in service until each of the future decision points. The use of a weighted average is similar to the Perceived Pay Model methodology. However, DRM views the weights as not only the odds of staying to a future point but also an individual's probability of not experiencing future random shocks. This concept has strong intuitive appeal. For example, an officer with high tastes who remained in service despite a perceived undesirable job assignment would certainly consider the probability of another negative shock in the future when confronting the stay or leave decision.

### **2. Criticism of DRM**

Criticism of the DRM concerns its complexity, particularly the extensive data requirements. Estimation of the DRM requires longitudinal data which presents a more difficult problem than cross-sectional data. Further, time-series analysis must be used with longitudinal data and this adds to the complexity and expense. While DRM appears to be the most theoretically sound of the models examined, its complexity and data requirements could discourage its widespread use [Ref. 20].

### **III. RESEARCH OBJECTIVES AND DESIGN**

#### **A. RESEARCH OBJECTIVES**

The principal research objective is to determine the effects of recent military retirement compensation changes on retention of Navy tactical pilots. A secondary objective is estimation of Navy tactical pilot retention determinants as a means of establishing a framework for evaluating changes in manpower policy. The research design must, of course, be both internally and externally valid.

#### **B. RESEARCH DESIGN**

The retention effects of a change in military compensation policy can be easily measured after the fact. Continuation<sup>4</sup> rates for the period following a change are observed and compared to rates in the period prior to the policy change. Estimates made before the fact are considerably more difficult to make. Because retention models try to quantify human behavior in economic terms, assumptions regarding individual behavior are necessary. Analysis of economic behavior seeks to reveal relationships between sets of independent characteristics and observed outcomes (in this case, retention). Once relationships are estimated, predictions based on these estimates are possible. Thus, given parameters of the observed relationship, effects of a change in this mapping can be estimated before the fact.

##### **1. The Estimation Problem**

One research objective of this thesis is to analyze retention outcomes for a specific population relative to a change in compensation policy (retirement pay). Unfortunately most existing models (ACOL, et al) were estimated from aggregate data, which limits their utility in this research. Estimates produced from aggregate data are not useful in examining specific sub-groups of a population. For example, when forecasting retention effects of proposed reductions in military retirement pay for a Department of Defense study, the ACOL model used a baseline current continuation rate for officers of 92.5 percent at the 8 YOS cell [Ref. 21]. The rate for Navy tactical

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<sup>4</sup>continuation rates are calculated by (1-loss rate) where loss rates are the percentage of the previous year's active duty total in a given YOS cell that are not on active duty the following year.

pilots was 46 percent. Further, the DOD aggregate data included Warrant and Limited Duty officers, both of which have considerable prior enlisted service. There is no homogeneity between Warrant Officers, for example, and tactical pilots. Clearly, the use of aggregate data can be inappropriate in focusing on specific sub-populations. To do so assumes constant tastes across job categories.

In examining a specific occupation it was necessary to construct a mathematical expression capturing indigenous relationships implicit in Navy tactical pilot retention behavior. Estimation parameters are often derived using data which links stay or leave behavior with individual characteristics. Historical data bases generally provide a good source and, indeed, provided data for the ACOL model. However, use of historical data is inappropriate for this study because of "grandfathering" provisions of the Military Retirement Act of 1986. The new law reduces retirement pay approximately 22 percent for all service members joining after July 31, 1986 [Ref. 22]. Those that were on active duty or were in a pre-commissioning training status prior to July 31, 1986, are not affected. Because the first Navy pilots subject to the revised law will not reach the first retention decision point until 1992, their choice behavior can not be observed. Thus it is necessary to use planned behavior for estimation. Determining retention plans becomes the key consideration in research design and a primary element affecting the internal validity of this research.

### C. DATA COLLECTION

The most effective method with which to obtain information on planned retention is simply to ask individuals their intentions. Three general methods exist with which to query a person: questionnaire, oral, or observational. As noted, it is not possible to use observational methods in this research. Pilots who will be affected by the new law have not reached their first retention decision point. Oral interviews also present limitations. While it would be desirable to interview each pilot, such a method is not practical. Cost and time constraints preclude use of this reliable technique.

Questionnaires offer many advantages. The most obvious is cost. Moser and Kalton [Ref. 23] point out the expense of printing questionnaires and distributing them to large numbers of people is considerably less than that of interviewing similar numbers of people. In the context of this thesis design, questionnaire use provides an additional advantage: it allows the researcher to query individuals who work unusual hours. Berdie and Anderson [Ref. 24] point out that researchers conducting personal

interviews frequently have trouble contacting people not in their office during normal hours. Questionnaires delivered to their home or office allow respondents to complete the survey at their leisure thus improving the response rate. An advantage like that is important to this study. Navy pilots do not keep regular hours and frequently, their office is in an airborne jet aircraft.

Questionnaires, therefore, were selected as the means of data collection. Goode and Hatt [Ref. 25] observe that the use of questionnaires in research is based on one basic, underlying assumption: the respondent will give truthful answers. The issue becomes one of how accurately actual retention is measured by an individual's stated intentions.

#### D. RELIABILITY OF STATED RETENTION BEHAVIOR

An important problem is to assess the reliability of stated retention behavior as a predictor of future behavior. Chow and Polich [Ref. 26] found a high correlation between stated and observed behavior with respect to first term reenlistment. This conclusion was reached by comparing stated intentions in the 1976 DOD Survey of Officers and Enlisted Personnel with actual results taken from the DOD master and loss file for March, 1977. The Chow and Polich data is shown in Table 1.

TABLE 1  
COMPARISON OF STATED INTENTIONS TO ACTUAL BEHAVIOR

Survey Response	Actual Percentage Reenlisting
Very Likely	81.6%
Undecided, but likely	60.6%
Undecided, but not likely	27.1%
Not reenlisting	06.2%

Hiller [Ref. 27] verifies the Chow and Polich work by looking at the statistical significance of their correlation coefficients. Hiller concludes that stated intentions are

accurate predictors of retention and, importantly, planned behavior is directly proportional to observed behavior. Put simply, service members do what they say.

## **E. THE SURVEY SAMPLE**

A primary consideration underlying the selection of a sample group was the research objective: the effects of changes in retirement pay on retention of Navy tactical pilots. In order for inferences to be made correctly about a specific population, therefore, the underlying sample group must be representative of the larger population. Obviously, the sample should be drawn from Navy tactical pilots.

At this point a special problem arose: who should be sampled - pilots currently on active duty and 'grandfathered' or prospective pilots yet to be commissioned who would serve under the new law? The decision was made to use current force members. The rejection of the use of prospective officers was based on two considerations; practicality and occupational cognizance.

During the time this thesis research was conducted (July 1986), prospective aviators had not entered the force yet<sup>5</sup>. It was impractical to query potential fliers because this group was unavailable.

### **1. Occupational Cognizance**

Even assuming potential aviators could be found, any inferences drawn from this group could be misleading. Prospective pilots have no cultural basis upon which to respond. That is, they have not experienced any of the factors native to the occupation such as arduous sea duty and hazardous flying conditions. Their tastes for military service are not yet fully defined<sup>6</sup>. Current force members, on the other hand, should have sufficient exposure to behavioral and environmental factors peculiar to their profession. Responses from individuals currently on active duty would provide valid data with which to conduct multivariate analysis.

### **2. Geographic Considerations**

Geographic location was a consideration in sample selection. At any given time, Navy tactical pilots working in a flying billet are assigned to aircraft squadrons located on both East and West coasts of the United States. The approximate geographic allocation is one half to the East and one half to the West. Appendix B provides a precise display of geographic distribution. To improve the questionnaire

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<sup>5</sup>The effective date of P.L. 99-348 was August 1, 1986.

<sup>6</sup>It would be akin to asking a truck driver, for instance, how he enjoyed working as a brain surgeon.

response rate, it was decided to hand-deliver the forms to squadrons, brief administrators, and hand-collect completed surveys. These were extraordinary but reasonable steps considering the traditionally poor response rate of mailed questionnaires. It has been observed that significant problems arise from poor response rates. If only a small percentage of mailed questionnaires respond, we can not be certain the results represent all subsets of the larger population [Ref. 28].

### 3. Selection of the Sample Group

West-coast-based A-4, FA-18, A-7, and F-14 pilots were selected as the sample. There were two principal reasons for this. First, all West coast aircraft selected are stationed at Naval Air Stations within California. The method of questionnaire distribution (hand delivery) posed considerable limitations. Foremost was time and funding. There was neither sufficient time nor money available for travel to East coast facilities. Therefore, the sample was limited to air stations in California. Second, the A-7, FA-18, A-4, and F-14 are designated by the Navy as tactical aircraft.

### 4. The Randomness Requirement

In order for the sample group to be representative, the larger population is defined to be West-coast-based Navy tactical pilots. This circumscription was necessary because, by definition, random selection requires all in a population to have an equal chance of being chosen. Implicit in the choice of West coast pilots is a recognition that East coast pilots do not have an equal chance of being selected. Satisfying the randomness requirement, therefore, guided the research population definition.

The manner in which the study population was delineated supports the external validity of the research design. Bracht and Glass [Ref. 29] explain this position:

It is better to have reliable knowledge about restricted sets of circumstances than to define the experimental population so broadly as to be uncertain about inferences from the sample to the population.

## F. THE INSTRUMENT

The design of the questionnaire centered on two objectives:

1. To elicit responses relevant to overall research objectives
2. To make completion easy.

The primary aim of this research is to predict retention of Navy tactical pilots as a function of change in retirement benefits by modeling individual behavior.

### 1. Avoidance of Bias

The dependent variable (retention) is constructed from a question that queries pilots about their expected decision to stay or leave *if they were serving under a law that provided retirement benefits identical to those specified in the new law*. Two elements of this question are important.<sup>7</sup> First, the question was phrased to avoid describing the retirement benefits as those of the new retirement law. If the respondents were told that the benefits described were, in fact, provisions of P.L. 89-439, their answers may not reflect true feelings but rather may indicate a protest towards what some may feel is an erosion of compensation. This type of bias is like an inverse "Hawthorne Effect"; a phenomenon observed and described by Roethlisberger and Dickson [Ref. 30]. The Hawthorne effect reflects distortion in behavior that occurs when people know they are the subjects of a study.

### 2. Effects of Independent Factors

The second important element in construction was the need to determine what factors other than retirement benefits may be influencing the respondent's decision. As a general rule, any dependent variable being observed may be affected by the influence of different factors and these variables may be related among themselves - sometimes operating in the same direction, sometimes in opposite. For example, a Navy pilot's decision to stay or leave may be influenced by a number of things. The officer implicitly assigns varying weights to each influencing factor in making a decision. Therefore, when querying a person about the impact of a specific policy the researcher must identify the other factors and understand the strength of their influence. To that end, a question was developed which asked a respondent to select from an array of alternatives that reason which had the strongest influence on the decision to stay. Table 2 shows this question.

### 3. The Taste Index

It was previously noted that econometric retention models vary widely in their ability to model individual tastes for military service. Some neglected this factor altogether while others attempted to capture tastes by assigning it a monetary value. In this thesis, a numerical taste indicator (NTI) was developed using responses to a series of questions pertaining to one's relative job satisfaction. This method was derived from

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<sup>7</sup>See Appendix A for a complete description of this question.

TABLE 2  
INFLUENCES ON DECISION TO REMAIN ON ACTIVE DUTY

Question 3

Below are some reasons Navy tactical air pilots and NFO's may have for remaining on active duty beyond their minimum obligated service. If you have considered staying in the Navy beyond your minimum obligated service, please circle one item number you feel was the most important reason why you would remain on active duty.

1. Opportunity to travel
2. Amount of total pay  
(includes base, sea, AOPC, BAQ, VHA, BAS, ACIP)
3. Opportunity for Command
4. Opportunity to fly tactical aircraft
5. Military benefits  
(includes: medical, exchange, commissary, recreation, space A travel)
6. Retirement Plan
7. Feeling of belonging to an elite organization
8. Stability of a Navy career
9. Find duty at sea rewarding

a similar question used in the 1978 *DOD Survey of Officers and Enlisted Personnel* [Ref. 31] and with minor modifications is the same question used by Black and Ilisevich [Ref. 32] to quantify the taste factor. Table 3 shows the taste question.

#### 4. Demographic data and Policy Analysis

Demographic data is included in the questionnaire both to assist in determining the relationship between the dependent variable (retention) and personal characteristics and to provide a descriptive statement about the sample.

The need to understand what correlation may exist between effects of policy changes and demographic structure is useful for those who develop policy. With a better understanding of the effects of proposed policy changes on specific subpopulations, decision makers are able to better estimate the economic and social

TABLE 3  
QUESTIONS USED TO DETERMINE TASTE INDEX

**QUESTION 5**

If you were to leave the service now and take a civilian job, how do you think that job would compare to your present military job in regard to the following work conditions?

	Civilian job would be a lot better	Civilian job would be slightly better	Civilian in a civilian and military job	Civilian job would be slightly worse	Civilian job would be a lot worse
1. The immediate supervisors	1	2	3	4	5
2. Having a say in what happens to me	1	2	3	4	5
3. The chance for interesting work	1	2	3	4	5
4. The work schedule and hours of work	1	2	3	4	5
5. The job security	1	2	3	4	5
6. Location of the job	1	2	3	4	5

costs as well as benefits of decisions. For example, if the military had a policy to increase the number of career minority officers and it was known that there was a strong negative correlation between minority officer retention and overseas job assignment, then any policy which failed to recognize that mapping could be counterproductive in terms of stated objectives. This hypothetical example demonstrates the extent to which inclusion of demographic data can be useful.

**5. Pre-testing of the Questionnaire**

Extensive pre-testing of the questionnaire was performed prior to distribution. It is recognized widely that pre-testing is the most effective means of ensuring the organization of the instrument is consistent with research objectives and the questions

are clear and well understood [Ref. 33]. Through observation and personal interviews during pre-test, any difficulties a respondent may have can be identified. This feedback is used to evaluate what modifications, if any, may be necessary.

The instrument used in this research was pre-tested on twenty-one Navy tactical pilots assigned to the Naval Postgraduate School. Ten of that group suggested improvements and, as a result, some wording was modified. After the revision, a second pre-test was done to ensure continued clarity.

## IV. MODEL SELECTION

To provide a reliable prediction of Navy pilot retention, an appropriate econometric model had to be selected. Such a model would have to be capable of providing justifiable estimators as well as data in a form conducive to statistical analysis.

Regression analysis has been used extensively in previous research. There are several good reasons for this. Regression is capable of providing significant explanatory power, especially through its multivariate capabilities; it is widely available in computer routines; and it is relatively simple to interpret.

As part of the model selection process, a number of different models will be discussed. Each will be evaluated on its usefulness in meeting the stated model objectives.

### A. LINEAR MULTIPLE REGRESSION

Research workers who wish to develop a model to predict a dependent output from a series of known, exogenous inputs will frequently use linear multiple regression. This form of analysis is concerned with modelling the relationship among the independent variables. An accurate representation of such a relationship is useful in two ways. First, it offers a powerful explanation of the dependent variable since few phenomenon are products of a single cause. Second, the effect of a particular independent variable is clarified for the possibility of distorting influence from other independent variables is removed.

In the general multiple regression equation, the dependent variable is seen as a linear function of more than one independent variable. The equation takes the form:

$$Y = a + \beta_1 X_1 + \beta_2 X_2 + \beta_n X_n$$

where

$Y$  = the prediction calculated from the equation

$a$  = the value of the intercept

$\beta_n$  = the coefficient of independent variable n

$X_n$  = the  $n^{\text{th}}$  independent variable value

## 1. Estimation by the Linear Model

The multiple regression equation quantifies the relationship between the dependent variable and multiple independent variables. If the true relationships among the variables were known precisely, the researcher could predict the outcome with great certainty. It is because the true relationship is rarely known that approximations must be generated from research data.

The regression equation coefficients, or parameters, are estimated by use of the least squares principle. This method attempts to fit the regression equation to observed data by minimizing the sum of the squares of prediction errors (SSE).

$$\text{SSE} = \sum(Y-K)^2$$

where  
Y = predicted value  
K = observed value  
(Y-K) = prediction error

Figure 4.1 Mathematical Basis of Least Squares Estimation.

The objective of least squares, therefore, is to select a straight line which minimizes the sum of the squares of the errors (SSE). For a two-variable model, the least squares notation is:

$$Y = a + b_1 X_1 + b_2 X_2$$

The least squares combination of values for the coefficients ( $a$ ,  $b_1$ ,  $b_2$ ) yields less prediction error (smaller SSE) than other possible combinations of values.

## 2. The Continuous Dependent Variable Constraint

Use of multiple linear regression is based on an assumption that the dependent variable is continuous. The use of estimates derived from linear regression where the dependent variable is qualitative rather than continuous can lead to serious errors in inference. For example, such estimates may seriously misestimate the magnitude of the effects of independent variables and, further, the regression estimates will be highly sensitive to the range of particular values observed for the independent variables. This observed sensitivity will make forecasts beyond the range of data unjustified [Ref. 34].

Use of qualitative dependent variables is important when analyzing individual retention behavior. The decision to remain on active duty (stay) or resign (leave) is a clear dichotomous choice. There can be no continuous behavior. The person either stays or leaves. Thus use of the linear model may be inappropriate. What is needed, therefore, are statistical techniques able to provide the type of information available from multivariate regression but with the ability to display estimates based on binary choices. Discriminant analysis and logistic regression are two methods that could be useful.

## B. DISCRIMINANT ANALYSIS

### 1. Usefulness in Prediction

The problem of forecasting attrition requires the researcher to determine who will leave and who will stay. An intuitive strategy is to compare characteristics of a pilot facing the stay or leave decision to those of pilots that have chosen to either remain in the Navy or leave. Based on similarities or differences, a prediction can be made. In essence, what the researcher attempts is to differentiate between two mutually exclusive, or dichotomous, groups: those who stay and those who leave. The ability to discriminate between the two groups is determined by a collection of variables representing individual characteristics such as age, commissioning source, and ethnic origin. What is known is variable values *for pilots whose group membership is known*. Other useful information would include the significance level of chosen variables as well as decision criteria necessary to predict group membership for those facing the stay or leave decision. Discriminant analysis is a statistical procedure designed for this problem.

### 2. How Discriminant Analysis Works

Discriminant analysis rests on a theory that specifies use of independent predictor variables, in linear combination, as a basis for classifying cases into one of two groups. Information contained in multiple independent variables is summarized in a single index. For example, by finding a weighted average of variables such as age, number of deployments, and flight hours, the researcher is able to obtain a score that distinguishes between pilots remaining on active duty from those that do not.

In discriminant analysis, the weights are estimated such that they result in the best separation between groups. The linear discriminant equation is specified by:

$$D = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n$$

where

D = discriminant score

X = values of the exogenous variables

$\beta$  = coefficients estimated from the data

If a linear discriminant function is to discern between pilots who stay and those who leave, the two groups must differ in their D value. Therefore coefficients are chosen so values of the discriminant function differ as much as possible between the groups [Ref. 35]. These coefficients are referred to as canonical discriminant function coefficients and can serve as a basis for classification of a pilot into one of two categories.

### C. THE LOGIT MODEL

In predicting retention, the focus should be on understanding determinants of individual choice behavior. As such we are interested in the tendencies to make expected choices, or probabilities. Because our retention choices are dichotomous (stay or leave) the dependent variable is binary in form. The decision to stay can be represented by 1; to leave by 0. As noted in the discussion of the linear model, there is strong reason to believe the additive linear form with 2 dichotomous dependent variables may provide poor probability approximations. Consider the following probability model:

$$P = \text{Prob}(Y=1) = f(X)$$

where

P = probability of an event

Y = a dependent variable (the event predicted)

X = an independent variable

$f(X)$  = cumulative probability function expressed  
in terms of X

### LOGISTIC DISTRIBUTION

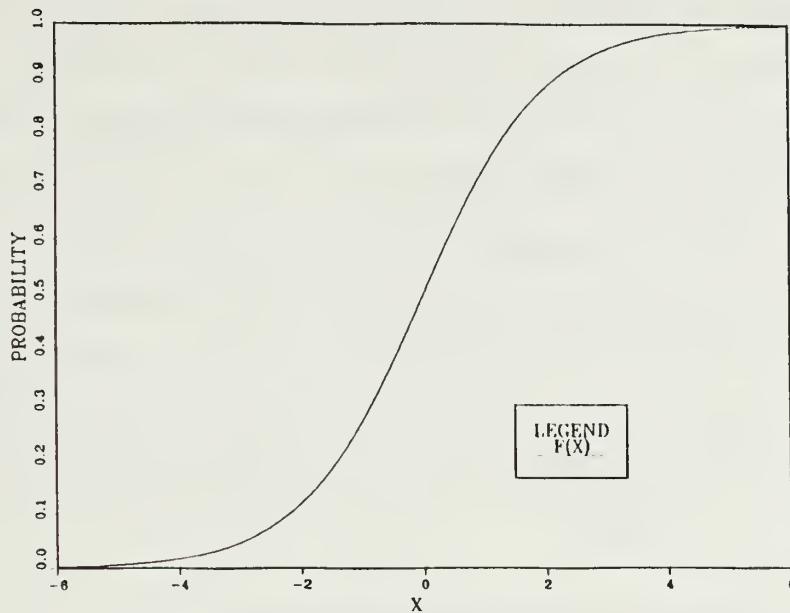


Figure 4.2 The Logistic Distribution.

Several characteristics of  $f(X)$  suggest that it is non-linear. First,  $f(X)$  must lie between 1 and 0 (see Fig. 4.2). Thus, the relationship must be non-linear at the boundaries otherwise discontinuities would result as the function was arbitrarily confined within the limits. Finally, where there is more than one explanatory variable the linear additive model seems inappropriate. At the least, one would expect some interaction between variables; the marginal change in probability associated with a given variable almost surely depends upon values of other explanatory variables [Ref. 36]. The logistic distribution provides a means for dealing with these problems:

$$\begin{aligned}
 P &= f(X) \\
 &= 1/(1 + e^{-\beta X})
 \end{aligned} \tag{eqn 4.1}$$

where

- $e$  = the base of natural logarithms
- $P$  = the probability that an individual will make a certain choice
- $X$  = an independent, explanatory variable
- $\beta$  = the coefficient associated with  $X$

The distribution ranges from 0 to 1 as  $X$  goes from  $-\infty$  to  $+\infty$ . Several aspects of this function account for its usefulness. First, it has convenient mathematical properties. Since

$$P = \frac{1}{1 + e^{-\beta X}}, \text{ as in equation 4.1, then}$$

$$\begin{aligned} 1-P &= e^{-\beta X} / 1 + e^{-\beta X} \\ &= \frac{1}{1 + e^{\beta X}} \end{aligned}$$

By manipulation, we derive

$$\begin{aligned} L &= \ln(P/(1-P)) \\ &= \ln(e^{\beta X}) \\ &= \beta X \end{aligned}$$

where  $L$  = logit, or log of the odds ratio.

As  $P$  goes from 0 to 1 ( $X$  goes from  $-\infty$  to  $+\infty$ ),  $L$  goes from  $-\infty$  to  $+\infty$ ; thus while probabilities are bounded, the logits are unbounded with respect to the values of the independent variables [Ref. 37]. This particular property of the logit model addresses the functional discontinuity problem posed by linear models.

## D. MODEL SPECIFICATION

### 1. Model Choice

Linear regression, discriminant analysis, and logit analysis have been arrayed as possible vehicles able to provide reasonable estimation of the retention decision. The linear model requires certain characteristics such as the continuous dependent variable assumption that precludes its use here as a predictor model. Unlike discriminant analysis, which postulates that observed values of individual characteristics are drawings from posterior distributions conditioned on actual responses, logit proposes that actual responses are drawings from binomial distributions with selection probabilities conditioned on observed values of individual characteristics *thus implying that it is natural to specify choice behavior in terms of selection probabilities, or logit analysis.*

## **2. Implications for Policy Makers**

An important consideration for decision makers is the effect changes in exogenous variables have upon the dependent variable. For example, manpower planners might be interested in the responsiveness of retention probability to changes in pay or non-pecuniary factors such as operating tempo. In the logit model, such analysis is possible because the functional specification of probabilities is assumed not to change. In the discriminant model, the relationship cannot be determined because there is no specification of a possible relationship involving the dependent and independent variables. [Ref. 38]

Thus the criterion for model specification is an ability to provide reasonable estimators and improve policy analysis utility through evaluation of retention determinants. Use of the logit model, therefore, seems appropriate.

## V. MODEL ESTIMATION

### A. VARIABLE DEVELOPMENT

Retention is the dependent variable. It measures an officer's decision to stay in service past minimum service requirement or leave. By assigning the value 1 to this dichotomous variable the study focuses on those who stay rather than those who leave. Previous research evaluated retention in the context of those who leave. Additional knowledge may be gained by analyzing the opposite choice. For example, it may be useful to know if factors thought to influence the stay decision are different from those believed to influence the leave decision. Table 4 describes the variable coding.

#### 1. Total Pay and Allowances

Pay is presented as a possible explanatory variable. Its inclusion represents an acknowledgement that Navy tactical pilots, as with most people, are rational beings motivated to a certain degree by monetary rewards for work. The pay variable measures total pay and allowances including bonuses specific to the tactical air community.

#### 2. Opportunity for Command

Navy tactical aircraft exist to oppose enemy forces at sea and to carry the battle ashore if need be. Command at sea of an operational unit is a dominant prerequisite for promotion to flag (Admiral) rank and represents a pinnacle of achievement in a competitive career. Many Navy officers see their command tour as a necessary milestone on the road to flag rank. Others see it as the capstone of a rewarding career. Thus the opportunity for command may be an influencing factor in the retention decision.

#### 3. Non-Monetary Military Benefits

Various non-monetary fringe benefits are available to service members. Such benefits include unlimited free medical care for the member and his family.<sup>8</sup>

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<sup>8</sup>Dependent medical care is by law on a space-available basis. If facilities are not available, dependents are encouraged to use CHAMPUS, a government sponsored health insurance program whereby dependents utilize civilian medical care. Premiums for this coverage are paid by the service member but are heavily subsidized by the government.

TABLE 4  
DEFINITION OF MODEL VARIABLES

Variable	Code
(RETN) Stated retention under new retirement law	1 = stay 0 = leave
(PAY) Pay is the primary reason I would stay past MSR	1 = yes 0 = no
(CMND) Opportunity for Command is the primary reason I would stay past MSR	1 = yes 0 = no
(FLY) Opportunity to fly tactical jets is the primary reason I would stay past MSR	1 = yes 0 = no
(BEN) Benefits such as medical, commissary, recreation, Space-A, and exchange are the primary reason I would stay past MSR	1 = yes 0 = no
(RETR) Retirement plan is the primary reason I would stay past MSR	1 = yes 0 = no
(ELI) Feeling of belonging to an elite organization is the primary reason I would stay past MSR	1 = yes 0 = no
(STA) Job security as a Navy pilot is the primary reason I would stay past MSR	1 = yes 0 = no
(YOS) years of service dummy	$\leq 8 = 1$ $> 8 = 0$

---

Commissioning Source

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(NAVCAD) Naval Academy	1 = yes; 0, otherwise
(ROTCR) ROTC (regular)	1 = yes; 0, otherwise
(AVROC) Aviation Reserve Officer Candidate	1 = yes; 0, otherwise
(AOCS) Aviation Officer Candidate	1 = yes; 0, otherwise
Other	1 = yes; 0, otherwise

TABLE 4  
DEFINITION OF MODEL VARIABLES (CONT'D.)

Variable	Code
<hr/>	
Aircraft Type	
I am assigned to fly:	
FA-18	1 = yes; 0, otherwise
A-7E	1 = yes; 0, otherwise
F-14	1 = yes; 0, otherwise
A-4 (includes F-5)	1 = yes; 0, otherwise
<hr/>	
Demographic Data	
(MARRD) Married	1 = yes; 0, otherwise
(DEPD) Dependents	1 = yes; 0, otherwise
(ETHN) Ethnic Origin	1 = caucasian; 0, otherwise
<hr/>	
Rank	
LTJG	1 = yes; 0, otherwise
(LET) Lieutenant	1 = yes; 0, otherwise
(LCDR) Lt. Commander	1 = yes; 0, otherwise
(CDR) Commander	1 = yes; 0, otherwise
(CAPT) Captain	1 = yes; 0, otherwise
<hr/>	
Other	
(SPOU) My spouse is employed	1 = yes; 0, otherwise
(TAST) Taste for military service	scale from 1 to 5
(DEPY) I have participated in a deployment over 3 months	1 = yes; 0, otherwise

Commissaries--military supermarkets--are another benefit. Commissary prices on a nationwide basis are about 20 percent lower than those prevailing in local commercial grocery stores [Ref. 39]. Exchanges--military department stores--represent another non-monetary benefit although savings from exchange purchases are not nearly as great as those from commissaries.

Another benefit is free worldwide travel (a \$10 processing fee is charged) via military aircraft on a space-available basis for the service member and his family.<sup>9</sup>

Military recreation facilities represent another attractive benefit. Golf courses, hobby shops, tennis facilities, swimming pools, theatres, and child care centers are available at subsidized prices. The largest source of subsidies are profits from the exchanges but regardless of the source, such subsidies should be recognized as non-cash compensation. As such, they may represent a factor in the retention decision.

#### **4. Retirement Benefits**

Both monetary and non-monetary returns to a service member upon retirement are major elements of the military compensation package. As such, any changes to retirement benefits may affect retention. Including this factor into the equation is important in evaluating what impact, if any, retirement pay has in the retention decision. The first question in the survey questionnaire asks for a stay or leave response in the context of altered retirement pay. The difficulty arises in determining the strength of retirement pay relative to other factors in a respondent's decision. By providing an array of possible determinants and asking the respondent to place a value on each, it is conceptually possible to evaluate the strength of any relationship between retention and each independent variable.

#### **5. Job Security in a Navy Career**

Military officers with a Regular commission earn tenure after reaching the O-5 rank. Involuntary separation, except for reasons of cause, hasn't occurred to Navy tactical aviators of any rank since de-mobilization following World War II. Thus it can be said that Navy jet pilots have a de facto guarantee of a twenty year career. Such job security may be viewed by these officers as an important part of the total compensation package. Therefore, the extent to which respondents value job security could have significant explanatory power in analyzing why some pilots stay and others leave.

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<sup>9</sup>Dependent travel is restricted to travel from the continental U.S. to overseas destinations and return. Dependents must be accompanied by the service member when traveling.

## **6. Opportunity to Fly Tactical Aircraft**

Psychic rewards associated with flying high-performance jet aircraft have long been suggested as a reason jet pilots stay in the Navy. There has been little formal research to substantiate this hypothesis, however. Opportunity to fly jets has been added to this model as a variable. By including this factor, the nature of any relationship may be more fully revealed.

## **7. Commissioning Source**

Dummy variables were added to capture the effects of a pilot's commissioning source on the probability of staying or leaving. Research by Cook [Ref. 40] suggests that very little difference in retention can be explained by commissioning source. Because the Cook study was performed six years ago, this variable was examined again. Relationships may change over time.

The linkage between source and retention is important to policy planners. For example, suppose commissioning source 'A' had an accession cost of \$100 and source 'B' had a cost of \$25. Further, suppose it was known that under a proposed pay increase pilots from source 'A' had a greater likelihood than pilots from 'B' of resigning at MSR. Using purely economic logic, increasing accessions from source 'B' relative to source 'A' could possibly provide a lower cost solution to maintaining given force levels beyond MSR.

## **8. Aircraft Type**

As with commissioning source, dummy variables were established for most types of Navy tactical aircraft. Evaluating retention probability under varying compensation scenarios while controlling for aircraft type can provide useful information. Department of the Navy aviation planners involved in long-range resource allocation might be interested in relationships between pilots who fly specific aircraft and retention.<sup>10</sup> Improved knowledge of this function could lead to a more efficient mix of resources and to a more proactive response to changes in pay or benefits. For example, if planners determined that under given a change in pay, F-14 pilots had a greater likelihood of resigning at MSR than FA-18 pilots, a policy of accessing more F-14 pilots relative to FA-18 pilots could prevent future shortages of F-14 pilots.

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<sup>10</sup>This relationship is referred to as the labor supply function and is measured by elasticity.

## **9. Airline Hiring Rates**

Airline hiring rates are thought to have a powerful effect on retention. Kleinman and Zuhoski [Ref. 41] found Navy pilot attrition to increase when airline hiring rates increase. These findings suggest that the Navy loses five pilots for every three Navy pilots hired by the airlines.

In the development of this author's model, respondents were asked about the influence airline hiring rates had on their decision to stay. Individual responses were taken up in a variable designed to capture effects of commercial air hiring on retention.

## **10. Spouse Employment**

The relationship between retention and spouse employment is a relatively unexplored topic. Derr [Ref. 42] provides a rich analysis of this retention problem aspect. He found cultural differences existing between junior (O-3)/midgrade (O-4) officers and senior (O-5+) officers particularly regarding importance of the family unit. Derr suggests that while senior officers tend to place job above family, junior and midgrade officers are placing increasing emphasis on the importance of family over job. Younger officers see their marriages more in terms of a partnership where each member is encouraged to seek individual fulfillment and share equally in household tasks rather than subjugating ones career aspirations to those of the other. If this analysis is correct, the implications for officer retention may be significant, particularly in the critical six to ten YOS period. In order to gather data on this subject, a dichotomous response variable was included in the model.

## **11. Tastes**

Because omission of the taste factor was seen as a shortcoming of other models, it was included in this model. The numerical taste index described in Chapter III was entered into the model as a continuous, independent variable. The index value was derived from questions shown in Figure 3 . Respondents were asked to rate each of six items on a scale of 1 (civilian job is best) to 5 (military job is best). Responses were summed across the six questions and a total mean for each respondent was obtained. A mean value of 3.00 could be interpreted as taste neutral; less than 3.00 as favoring a civilian work environment; and greater than 3.00 as favoring a military occupational environment.

## B. ESTIMATION PROCEDURE

The Navy pilot retention model developed in this thesis is estimated using non-linear, maximum-likelihood estimation procedures. An assumption is made that the probability of retention is given by the odds-ratio logistic function of a linear combination of independent variables. The Statistical Analysis System (SAS) LOGIST procedure was used to develop maximum likelihood estimates (MLE) of the exogenous variables.

### 1. Use of Maximum Likelihood Estimates

Maximum likelihood is used rather than ordinary least squares estimation because the logistic functional form is non-linear. The maximum likelihood procedure has a number of desirable statistical properties. For large samples, parameter estimates are consistent and asymptotically efficient [Ref. 43]. In addition, all parameter estimates are known to be asymptotically normal, so appropriate statistical tests are possible.

The LOGIST procedure computes MLE's by the Newton-Raphson method. The model chi-square, its p-value, degrees of freedom, and an r statistic are displayed as output for each model. The model chi-square for each cumulative set of independent variables is twice the difference in log likelihood of the corresponding model from the likelihood based on the intercept only. It is the value:

$$\text{model chi-square} = r^*(n-p)/(1-r) \quad (\text{eqn 5.1})$$

where

p = number of parameters in the model including the intercept

n = number of observations

In the logistic transformation, the r statistic is equivalent to  $R^2$  in the linear model, ranges between 0 and 1, and provides a measure of a variable's contribution independent of sample size.

### 2. Capability for Sensitivity Analysis

Policy analysts may find useful the ability to forecast the change in a dependent variable resulting from change in an independent variable. This type of analysis is available using logistic regression. Because the function is non-linear, the slope can only be evaluated by taking derivatives of the coefficients. Each resulting

value represents a first-order partial derivative which shows the effects of unit changes in an explanatory variable on retention probability. A more detailed explanation of the procedure and proofs can be found in Hanushek and Jackson [Ref. 44].

## VI. RESULTS AND ANALYSIS

### A. DESCRIPTIVE STATISTICS

Table 5 shows a summary display of the aggregate, pooled, cross-sectional data set. There were 302 observations drawn from 350 distributed questionnaires. The response rate was 86 percent.

TABLE 5  
AGGREGATE SAMPLE DATA

DETERMINANTS OF NAVY TACTICAL PILOT RETENTION  
STEPWISE LOGISTIC REGRESSION PROCEDURE

DEPENDENT VARIABLE: RETN   WOULD STAY IN PAST MSR UNDER NEW LAW

VARIABLE	MEAN	MINIMUM	MAXIMUM	RANGE
302 OBSERVATIONS				
226 RETN = 0				
76 RETN = 1				
PAY	0.155629	0	1	1
CMND	0.072847	0	1	1
FLY	0.350993	0	1	1
BEN	0.026490	0	1	1
RETR	0.115894	0	1	1
ELI	0.036423	0	1	1
STA	0.049668	0	1	1
YOS	0.533113	0	1	1
NAVCAD	0.235099	0	1	1
ROTCR	0.195364	0	1	1
AVROC	0.165563	0	1	1
AOCS	0.350993	0	1	1
F18	0.288079	0	1	1
A7	0.324503	0	1	1
F14	0.274834	0	1	1
A4	0.112583	0	1	1
MARRD	0.662252	0	1	1
DEPD	0.711921	0	1	1
DEPY	0.860927	0	1	1
LET	0.609272	0	1	1
LCDR	0.268212	0	1	1
CDR	0.079470	0	1	1
AIRL	0.562914	0	1	1
SPOUSE	0.268212	0	1	1
TAST	2.825030	1.33	3.83	2.5

Seven variables described in Chapter V were used in the model estimation to indicate a respondent's most important reason for staying past MSR (PAY, CMND, FLY, BEN, RETR, ELI, STA). Ranked by mean response, FLY (Opportunity to fly tactical aircraft) had the highest score for the aggregate data. For the group as a whole (stayers and leavers), the FLY variable was the most important factor. The mean value<sup>11</sup> for FLY is .3509.

The mean for years of service (YOS) is .5331 which indicates the sample group is equally distributed between pilots who have more or less than eight years of service. However, the actual distribution is skewed slightly (.0331) toward the junior group.

Appendix E (page 83) provides a frequency summary of respondents by commissioning source. Those officers commissioned from Aviation Officer Candidate School (AOCS) are the best represented, while Aviation Reserve Officer Candidate (AVROC) pilots were the least well represented.<sup>12</sup> Percentages of the total sample by each commissioning source are: AOCS, 35%; Naval Academy, 23%; ROTC (regular), 19.5%; AVROC, 16.5%; and other, 5.3%.

Appendix E (page 84) is a summary of respondents by aircraft type. Pilots assigned to fly A-7E jets were the largest sub-group of the sample. FA-18 and F-14A pilots were about evenly distributed while pilots who fly A-4 jets were in a minority. A-7E pilots were 32% of the total, while those who fly FA-18, F-14A, and A-4 aircraft were 28.8, 27.4, and 11.3 percent, respectively.

Respondents sorted by rank were distributed similarly to the actual pilot population. Appendix E (page 85) is a summary of how respondents are represented by rank. Lieutenants ( $n = 184$ ) were the largest group accounting for 61% of the total. Next were Lieutenant Commanders ( $n = 81$ ) with 27% while Commanders ( $n = 24$ ) were 8%. Lieutenant Junior Grade Officers (3%) and Captains (1%) accounted for the balance.

66 percent of sample respondents were married ( $n = 200$ ). 27 percent of the group had spouses who worked outside the home and 99 percent of the respondents were Caucasian. A large majority (86%) had been on deployments longer than three months. The mean for the airline-hiring effect variable was .563. This finding suggests

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<sup>11</sup>The reader is reminded the range for these variables is 0 to 1.

<sup>12</sup>Officers from "other" sources were the least represented in absolute terms. Their small size ( $n = 16$ ) relative to the larger sample size made this group less important for analytical purposes.

that more than 56 percent of the total group were influenced by the rate at which airlines are procuring new pilots. The mean for the tastes variable was 2.825.

## B. THE ESTIMATED EQUATION

The following LOGIT regression equation (eqn 6.1) was obtained from the cross-sectional data set of 302 West-coast based Navy tactical pilots under study:

$$\begin{aligned} \text{Ln}\{\text{P}/(1-\text{P})\} = & -7.854 + 1.1832(\text{PAY}) \\ & + 2.8677(\text{STA}) + .8796(\text{ROTCR}) \\ & -1.7929(\text{AIRL}) - 1.5185(\text{SPOU}) \\ & + 2.4793(\text{TASTE}) \end{aligned} \quad (\text{eqn 6.1})$$

where

Ln = natural log

P = probability of retention past MSR

Table 9 presents coefficients for each parameter together with corresponding standard error, chi-square, p value, and r value. The chi-square of the estimated equation is significant and, with a p-value of .000, passes the test of model accuracy. The 'c' index (fraction of concordant pairs of predicted probabilities and responses) is a good way to assess a logistic model's predictive ability. This index measures from 0 (no ability) to 1 (perfect ability). In the equation, the 'c' index is .866.

The estimated equation suggests that pay, job security, being commissioned from ROTC, the rate of airline hiring, whether a spouse is employed, and taste for military lifestyle increases the probability that a tactical pilot will remain beyond MSR. While these variables have the strongest effects (1% level of significance), other factors have an important, if somewhat less significant, contribution.

## C. RETENTION PREDICTIONS

Retention is defined in two forms: minimum service requirement (MSR) plus two years (MSR + 2) and continuation rates. By the use of years of service (YOS) dummy variables, retention rates were estimated for both definitions.

TABLE 9  
ESTIMATED EQUATION STATISTICS

MODEL CHI-SQUARE= 97.10 WITH 6 D.F. (SCORE STAT.) P=0.0  
 CONVERGENCE OBTAINED IN 6 ITERATIONS.  
 MAX ABSOLUTE DERIVATIVE=0.5170D-05. R= 0.549  
 MODEL CHI-SQUARE= 114.69 WITH 6 D.F.

VARIABLE	BETA	STD. ERROR	CHI-SQUARE	P	R
INTERCEPT	-7.80361297	1.38139267	31.91	0.0000	
TAST	2.48623652	0.44971654	30.56	0.0000	0.290
AIRL	-1.86346878	0.36199618	26.50	0.0000	-0.268
STA	2.70555144	0.71646539	14.26	0.0002	0.190
PAY	1.16039265	0.45242503	6.58	0.0103	0.116
SPOUSE	-1.53375610	0.50332474	9.29	0.0023	-0.146
ROTCR	0.86369012	0.43028735	4.03	0.0447	0.077

FRACTION OF CONCORDANT PAIRS OF PREDICTED PROBABILITIES AND RESPONSES: 0.866

RANK CORRELATION BETWEEN PREDICTED PROBABILITY AND RESPONSE: 0.747

### 1. Minimum Service Requirement Plus Two (MSR + 2)

The LOGIT model estimates that 25.17 percent of Navy tactical pilots serving under the Military Retirement Reform Act of 1986 will continue on active duty beyond MSR + 2. This contrasts with a fiscal year (FY) 1986 MSR + 2 rate of 46 percent and is a reduction in retention of 45 percent.

### 2. Continuation Rates

Continuation rates are derived from the following:

$$C_r = 1 - (L_r / N_r)$$

where

$C_r$  = Continuation rate in YOS cell r

$L_r$  = Losses during the year in YOS cell r

$N_r$  = Number in YOS cell r at beginning of the year

Figure 6.1 shows a graphical display of the estimated continuation rates and Appendix D has a complete listing of the rates.

#### D. ANALYSIS OF THE RETENTION DECISION

The decision to stay or leave was analyzed by aircraft type, marital status, commissioning source, and rank.

Retention by aircraft type reveals that A-7E pilots have a greater probability than others of staying past MSR. A-7E fliers represented 32.5 percent of all respondents, yet accounted for 38.2 percent of those predicted to stay in the Navy. A-4/F-5 pilots had the second greatest probability with 11.3 percent of responses and 11.8 percent of predicted stayers. FA-18 aviators had the third highest probability of staying while F-14A pilots had the lowest of the group. Table 10 displays the data.

Retention by commissioning source indicates that tactical pilots accessed from the Reserve Officers Training Corps (regular) had the greatest probability of retention. ROTC aviators were 19.5 percent of the total but represented 25 percent of those predicted to stay. Pilots commissioned from the Naval Academy had the second highest chance. Naval Academy graduates were 23.5 percent of the total and were 23.7 percent of the predicted stayers. AOCS and AVROC sources were third and fourth, respectively. Table 11 provides a tabular display of this dimension.

When examining retention by rank, it is clear that Captains and Commanders have the highest probability of staying (see Table 12). For example, Commanders were 8 percent of the total and 13.2 percent of the predicted stayers. This finding is not unexpected considering the increase in average tastes due to self-selection as officers become more senior. What is surprising is the large numbers of senior officers who would leave active duty at MSR despite high tastes. A more useful analysis of this group would be to look at the percentage that are estimated to leave. For Commanders, 58 percent would not stay. Lt. Commanders had a 64 percent chance of leaving and Lieutenants had a 82 percent probability of not staying beyond MSR. The observation that a large percentage of senior officers would leave despite high tastes is related to a perceived decrease in monetary compensation. Officers with high tastes are willing to trade-off some level of monetary compensation for other benefits. However, if pay is thought to be eroding and other benefits remaining stable, the balance is tipped and some officers with high tastes will leave. Apparently, this is the case with the new retirement law. The evidence suggests that many senior officers surveyed felt a 22+ percent decrease in retirement pay is enough to alter the balance.

## ESTIMATED CONTINUATION RATES

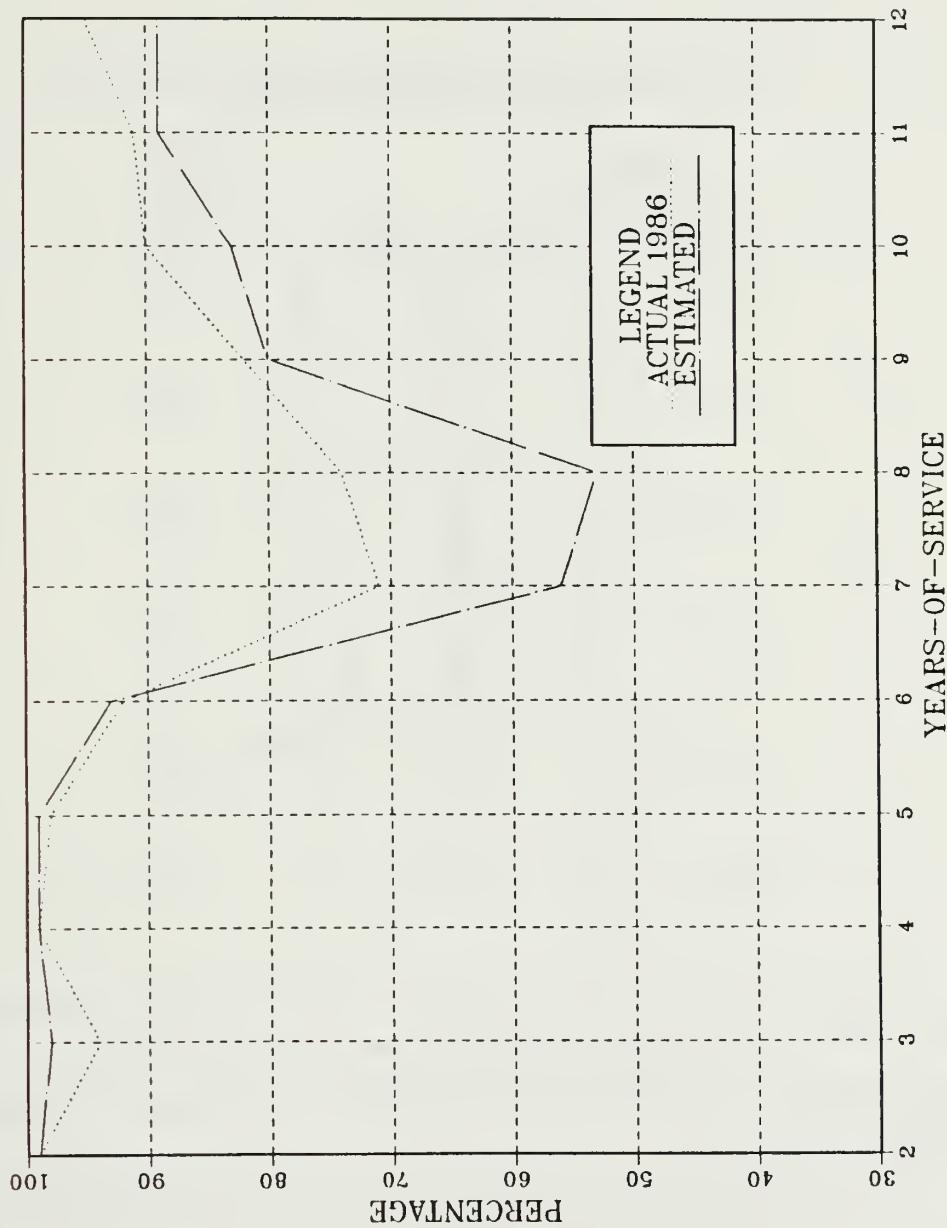


Figure 6.1 Estimated Continuation Rates.

TABLE 10  
RETENTION BY AIRCRAFT TYPE

DETERMINANTS OF NAVY TACTICAL PILOT RETENTION  
TABLE OF AIRCRFT BY RETN

	FREQUENCY PERCENT	ROW PCT	COL PCT	LEAVE	STAY	TOTAL
A4	25	9	34			
	8.28	2.98	11.26			
	73.53	26.47				
	11.06	11.84				
F14	65	18	83			
	21.52	5.96	27.48			
	78.31	21.69				
	28.76	23.68				
A7	69	29	98			
	22.85	9.60	32.45			
	70.41	29.59				
	30.53	38.16				
F18	67	20	87			
	22.19	6.62	28.81			
	77.01	22.99				
	29.65	26.32				
TOTAL	226	76	302			
	74.83	25.17	100.00			

As shown in Table 13, single tactical pilots are more likely to leave than married fliers. However, the converse is not always true. While married pilots as a whole have a higher probability of staying than single aviators, married pilots whose spouses are employed do not.

The impact of spousal employment was shown to be significant in the regression equation. While pilots whose spouses were employed accounted for only 27 percent of the sample, these same fliers represented 33 percent of the predicted leavers. This is shown clearly in Table 14 .

The negative relationship between spouse employment and staying on active duty may be related to assignment stability. This would be particularly true if a pilot's

TABLE 11  
RETENTION BY COMMISSIONING SOURCE

DETERMINANTS OF NAVY TACTICAL PILOT RETENTION  
TABLE OF SOURCE BY RETN

FREQUENCY PERCENT ROW PCT COL PCT			TOTAL
	LEAVE	STAY	
OTHER	12 3.97 75.00 5.31	4 1.32 25.00 5.26	16 5.30
AOCS	81 26.82 76.42 35.84	25 8.28 23.58 32.89	106 35.10
AVROC	40 13.25 80.00 17.70	10 3.31 20.00 13.16	50 16.56
ROTC	40 13.25 67.80 17.70	19 6.29 32.20 25.00	59 19.54
NAVAL ACADEMY	53 17.55 74.65 23.45	18 5.96 25.35 23.68	71 23.51
TOTAL	226 74.83	76 25.17	302 100.00

spouse had a job specific to a certain geographic location. For these couples, opportunity costs are associated with transfer orders. For example, if a spouses' job prospects are thought to be poorer at the new location, the opportunity cost of being transferred is high. This represents an economic cost to continued service on active duty. All factors constant, this opportunity cost is a reduction in the income stream and, therefore, reduces the likelihood of retention.

TABLE 12  
RETENTION BY RANK

DETERMINANTS OF NAVY TACTICAL PILOT RETENTION  
TABLE OF RANK BY RETN

FREQUENCY	PERCENT	ROW PCT	COL PCT			TOTAL
				LEAVE	STAY	
LTJG	9	0	2.98	9		
	2.98	0.00		0.00		
	100.00	0.00		0.00		
	3.98	0.00		0.00		
CAPT	0	4	1.32	4		
	0.00	1.32		1.32		
	0.00	100.00				
	0.00	5.26				
CDR	14	10	7.95	24		
	4.64	3.31		7.95		
	58.33	41.67				
	6.19	13.16				
LCDR	52	29	26.82	81		
	17.22	9.60		26.82		
	64.20	35.80				
	23.01	38.16				
LT	151	33	60.93	184		
	50.00	10.93		60.93		
	82.07	17.93				
	66.81	43.42				
TOTAL	226	76		302		100
	74.83	25.17				

## E. ANALYSIS OF THE AIRLINE FACTOR

### 1. Controlling for Commissioning Source

The results reveal that pilots commissioned from the Aviation Reserve Officer Candidate (AVROC) source were the most likely to be influenced by airline hiring rates. With 16.5 percent of the responses, AVROC pilots accounted for 19.4 percent of those who said airlines affected their decisions. The least likely group to be influenced are Aviation Officer Candidate School (AOCS) pilots. This group represented 35 percent of the sample but only 30 percent of those influenced by the prospects of flying for commercial aviation.

TABLE 13  
RETENTION BY MARITAL STATUS

DETERMINANTS OF NAVY TACTICAL PILOT RETENTION  
TABLE OF MARRD BY RETN

	FREQUENCY	PERCENT	ROW PCT	COL PCT	LEAVE	STAY	TOTAL
SINGLE					82	20	102
					27.15	6.62	33.77
					80.39	19.61	
					36.28	26.32	
MARRIED					144	56	200
					47.68	18.54	66.23
					72.00	28.00	
					63.72	73.68	
TOTAL					226	76	302
					74.83	25.17	100.00

## 2. Controlling for Aircraft Type

An examination of the airline factor by aircraft type indicates that F-14A pilots are influenced proportionally greater than others. F-14A fliers were 27.4 percent of the sample and 33.5 percent of the "influenced" respondents. FA-18 pilots were generally ambivalent, totalling 28.8 percent of the sample and 28.8 percent of the "influenced" group. A-4 aviators were the least influenced by the attractions of commercial aviation with 11 percent of the sample and 8.8 percent of those stating they were influenced.

## 3. Controlling for Rank

Analysis of the airline factor by rank reveals that by far, Lieutenants are influenced the greatest. Accounting for 61 percent of the sample, Lieutenants totalled 71.8 percent of the "influenced" category. Captains and Commanders were the least influenced. If low sensitivity to airlines hiring rates is a proxy for job satisfaction, these data provide further evidence that average tastes increase with YOS and results from

TABLE 14  
RETENTION BY SPOUSE EMPLOYMENT

DETERMINANTS OF NAVY TACTICAL PILOT RETENTION  
TABLE OF SPOUSE BY RETN

	FREQUENCY	LEAVE	STAY	TOTAL
	PERCENT			
	ROW PCT			
	COL PCT			
NOT EMPLOYED		152 50.33 68.78 67.26	69 22.85 31.22 90.79	221 73.18
EMPLOYED		74 24.50 91.36 32.74	7 2.32 8.64 9.21	81 26.82
TOTAL		226 74.83	76 25.17	302 100.00

the self-selection process. Those pilots who have low tastes and are strongly attracted to commercial air have, by the time of eligibility for promotion to Captain, selected themselves out of the Navy.

#### 4. Controlling for Spouse Employment

The airline factor has a greater proportionate influence on the retention decision of pilots whose spouses are employed than those whose spouses are not employed. The former group accounted for 27 percent of the sample and 32 percent of those "influenced" while the latter group was 73 percent of the sample and 67 percent of those "influenced." This finding is intriguing but lacks a *prima facie* explanation. Table 15 provides a summary for the airline factor.

### F. EFFECTS OF PREDICTOR VARIABLES

#### 1. Military Pay and Bonuses

The amount of pay, allowances, and bonuses a tactical pilot receives has a strong effect on his likelihood of staying in service. Pay was found to be statistically

TABLE 15  
THE AIRLINE HIRING FACTOR

Controlling for Commissioning Source

Source	sample %	influenced	proportion
AVROC	16	19.4	21.3 %
ROTC	19	23	21.0 %
NAVCAD	23	24	4 %
AOCS	35	30	-14.0 %

Controlling for Aircraft Type

aircraft	sample %	influenced	proportion
F-14A	27.4	33.5	22.2 %
FA-18	28.8	28.8	0.0 %
A-7E	32.0	28.8	-10.0 %
A-4	11.0	8.8	-20.0 %

Controlling for Rank

rank	sample %	influenced	proportion
LT	61.0	71.8	17.0 %
LTJG	3.0	3.5	16.0 %
LCDR	27.0	20.5	-24.0 %
CAPT	1.0	.6	-43.0 %
CDR	8.0	4.1	-49.0 %

significant at the 1 percent level. Evaluated for pilots on the margin (prob = .5), a one percent increase in pay is estimated to increase retention probability by 0.30 percent.

## **2. Job Security**

In absolute terms, job security has the largest influence of all factors examined on predicted retention. Significant at the 1 percent level, job security is the most important reason tactical pilots serving under the new retirement law may have for staying in the Navy. This is an important finding because prior research has not identified this factor as significant to the retention decision. Positive coefficients suggest that as a pilot's perceived job security improves, the likelihood of this person being retained also improves.

## **3. Commissioning Source**

Of all commissioning sources examined, officers from the Reserve Officers Training Corps (ROTC) have the largest positive tendencies to being retained past MSR. The ROTC coefficient is significant at the 5 percent level. Sensitivity analysis reveals a one percent increase in officers commissioned from ROTC will yield a 0.23 percent increase in retention when evaluated at MSR+2 retention rates. No other commissioning source met the 10 percent significance level criterion for inclusion into the model.

## **4. Airline Hiring Rates**

As might be expected, the rate at which airlines are hiring new pilots has a significant (1%) effect on estimated retention. The coefficient is negative (-1.853) which indicates an inverse relationship between airline hiring and retention of pilots who will serve under the new retirement law. The evidence further suggests that a Navy pilot's attraction to commercial aviation has two dimensions: tastes (job satisfaction) and pay. For example, in 1986, airline hiring rates increased albeit at lower average starting salaries while tactical pilot retention decreased. The fact that many Navy pilots are willing to accept the same, or in some cases lower, airline pay relates to job satisfaction. For pilots with low tastes, higher Navy pay will not provide sufficient inducement to stay.<sup>13</sup>

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<sup>13</sup>For a concise analysis of the Navy and airline pay comparability issue, see Henderson and Kriegel (ref 45).

## **5. Spouse Employment**

The employment of a tactical pilot's spouse outside the home has a strong inverse relationship to retention. The coefficient of -1.534 is significant at the 1 percent level and indicates that, for the pilot at the margin (prob = .5) whose spouse is employed, there is a 0.38 percent higher likelihood of his leaving at MSR than marginal pilots whose spouses are not employed leaving at MSR.

## **6. Tastes**

A tactical pilot's tastes for the military has the second largest influence on retention of all factors examined. Significant at the 1 percent level, tastes can make a large impact on retention relative to other factors. The coefficient of 2.4862 is positively correlated. This suggests that as a person's tastes for military service rise, the probability of his staying past MSR also rises. The retention elasticity with respect to tastes is 3.92.<sup>14</sup> This means that for a 1 percent increase in job satisfaction, retention rates could be expected to rise nearly 4 percent, all other factors remaining constant.

To the extent that the taste variable is a proxy for pilot job satisfaction, Navy policy makers can positively influence retention rates by altering certain aspects of the job. For example, the difficult conditions associated with extended carrier deployments have been recognized as detriments to retention. Consequently, the Secretary of the Navy has taken steps to reduce carrier operating tempo [Ref. 46]. A tabular display of the tastes factor by commissioning source, aircraft type, and rank is shown in Appendix F.

## **7. Opportunity to Fly Tactical Aircraft**

Opportunity to fly tactical aircraft failed to meet the 10 percent significance level criterion for inclusion into the model. This variable, if it could be interpreted, will exert less influence on those serving under the new retirement law than other factors will. For the entire sample (stayers and leavers), opportunity to fly tactical aircraft was the most frequently given reason for staying; for the stayers, however ( $n=76$ ), it was less important than job security and total monetary compensation.

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<sup>14</sup>Elasticities evaluated at the 1986 Navy tactical pilot retention rate of 46% ( $MSR + 2$ ).

## VII. SUMMARY AND CONCLUSIONS

### A. SUMMARY

Retention rates have been estimated for Navy tactical pilots who will serve under the provisions of the Military Retirement Act of 1986 (P.L. 99-348). Estimation was done by the LOGIST procedure which fits the logistic multiple regression model to a single binary dependent variable. Maximum likelihood estimates were computed by the Newton-Raphson method. The LOGIST procedure was chosen as the estimation model after critical review of the PPM, PVCOL, ACOL, and DRM methodologies.

Data were obtained from a cross-sectional random sample ( $n=302$ ) of West-coast based Navy Tactical pilots. Retention estimates for both minimum service requirement plus two years (MSR + 2) and continuation rates (1-loss rate) were provided. Estimating retention rates satisfies the first research objective described in Chapter III. Another research objective was to evaluate determinants of Navy tactical pilot retention. Taste for military service, pay, job security, commissioning source, and spouse employment were found to have statistically significant effects on a tactical pilot's retention decision.

### B. CONCLUSIONS

Conclusions presented in this section result from analysis of data drawn from the Navy tactical pilots survey described in Chapter III.

Conclusion 1: *The Military Retirement Act of 1986 will have a negative impact on Navy tactical pilot retention.* This conclusion is predicated on existing civilian-military pay ratios, operational tempo, and quality-of-life factors remaining constant. The negative impact will be felt directly beginning in 1992 for the 1986 entering cohort. Spillover effects may be felt sooner. For example, current pilots who are on the margin may see the new law as a signal that their compensation package is under Congressional attack. Barring improvements in other areas, this implied threat may induce these undecided officers to leave.

Conclusion 2: *Tactical pilot accession levels can be expected to begin rising significantly by the end of the decade given current or higher force requirements.* As retention rates begin to drop first reflecting spillover and then direct effects, higher accession levels will be necessary to maintain force levels.

*Conclusion 3: Tactical pilot accession funding requirements will increase as higher accessions enter the training pipeline. Financial costs will be felt more strongly in the tactical air community than others given higher marginal training costs for tactical aviators.*

*Conclusion 4: Non-monetary factors will have a greater impact on retention than monetary factors* given current civilian-military pay ratios. Perceived job security will be important in maintaining acceptable continuation rates. This conclusion is reasonable considering that officers serving under the new law will be evaluating a trade-off between job security and earnings stream. If future earnings are expected to decrease (lower retirement pay), rational tactical pilots will demand higher levels of job security as an inducement to stay. The evidence in this research strongly suggests that for the pilot on the margin, job security is valued more than any other factor. If one accepts this finding, it is logical to argue that discussions by higher authority which are perceived to be threats to job security will reduce retention. For example, reductions in force of regular officers could be seen as a threat to job security. As such it can be expected to reduce retention.

*Conclusion 5: Tactical air retention will continue to be sensitive to airline hiring rates.* The evidence suggests that a tactical pilot's monetary compensation has risen enough in the last five years to provide an adequate level of economic satisfaction given average tastes distribution. Therefore, the economic incentives of leaving to join the airlines are not so great as they once were. However, for those with low tastes, the non-monetary attractions of commercial aviation will continue to be enticing.

*Conclusion 6: Spouse employment will continue to have a negative impact on retention.* The number of two-income marriages is increasing, and Naval aviation, like other sectors of society, will continue to feel the impact of this social force. Because of opportunity costs associated with transfers, increasing levels of spousal income will exacerbate the negative impact of spouse employment on retention.

*Conclusion 7: Bonus levels must remain fully funded if current or higher tactical force levels will be required.* Bonuses are used to retain pilots with low tastes. Therefore, imbedded in current retention rates are lower average taste levels than would exist if prior bonuses had not been paid. Stated simply, because a certain percentage of retention is tied to these temporary inducements (bonuses), higher exit-rates will occur if current bonus values are eroded.

## APPENDIX A

### SURVEY QUESTIONNAIRE

#### *1986 Navy Tactical Air Survey*

The ability to attract and retain qualified tactical air pilots and NFO's is a matter of high priority to Navy Manpower planners. This survey is a *key element* of research being conducted for a Masters Thesis at the Naval Postgraduate School. Data collected will be used to evaluate how alternative policies may affect individual career decisions. Results of this research will be reviewed by the Office of the Chief of Naval Operations and may lead to improved pay and quality of life initiatives in the future. This questionnaire is being distributed to a sample of Naval Aviators and Flight Officers. Please read the instructions below.

#### *NOTICE*

This survey is anonymous. Information you provide will be grouped with that of the other participants and *provisions of the Privacy Act will be enforced*. Please do not write your name on the questionnaire.

Your participation in this survey is voluntary. You are encouraged to provide complete and accurate information, but you are not required to answer any question you consider objectionable.

Your responses to this survey will be aggregated and used to prepare a statistical report. Summary results of this survey will be provided to each squadron upon completion.

Suppose the Armed Forces had a *different* retirement plan in effect at the time you first entered active duty. Under this new plan, people who remain in the military for 20 years or more would receive the following benefits:

1. For twenty years of service, retirement benefits will equal 40% of the average pay for the highest three years of *basic pay*.
2. The percentage of basic pay will increase 3.5% per year after 20, up to a maximum of 75% at 30 years.

In Addition:

*3. Inflation Protection*

Annual cost of living increases for retired pay will be held to 1% below the annual inflation rate. At age 62, however, the retiree will get a one-time increase to restore purchasing power lost to inflation. After that, the cost of living adjustments will again be 1% less than inflation.

The plan described above represents an approximate twenty percent decrease in benefits from the plan that most active duty military members now serve under.

*QUESTION 1*

If the benefits described above had been available at the time you entered active duty, and all operational and quality of life factors were held constant at today's level (such as airline hiring rates, deployment tempo, pay/bonus levels, etc), would you have stayed on active duty past your obligated service?

(please circle response)

Yes      No

If the answer to the above is Yes, how many years from date of commissioning would you have stayed?

answer: \_\_\_\_\_.

*If you are not planning to remain on active duty beyond your minimum obligated service, please DO NOT answer questions 2 and 3. Skip to question 4.*

## Question 2

How important are the following factors in making your decision to remain on active duty beyond your minimum obligated service?

	very important	moderately important	somewhat important	slightly important	not important
1. Opportunity for travel	1	2	3	4	5
2. Amount of total pay, bonuses, and allowances	1	2	3	4	5
3. Opportunity for Command	1	2	3	4	5
4. Opportunity to fly tactical aircraft	1	2	3	4	5
5. Military benefits (includes medical, commissary, space A travel, PX, etc.)	1	2	3	4	5
6. Retirement plan	1	2	3	4	5
7. Feeling of belonging to an elite group	1	2	3	4	5
8. Job security in a Navy career.	1	2	3	4	5
9. Rewards and challenges of duty at sea.	1	2	3	4	5

Question 3 Below are some reasons Navy tactical air pilots and NFO's may have for remaining on active duty beyond their minimum obligated service. If you have considered staying in the Navy beyond your minimum obligated service, please circle one item number you feel was *the most important* reason why you would remain on active duty.

1. Opportunity to travel
2. Amount of total pay (includes base, sea, AOCP, BAQ, VHA, BAS, ACIP)
3. Opportunity for Command
4. Opportunity to fly tactical aircraft
5. Military benefits (includes: medical, exchange, commissary, recreation, space A travel)
6. Retirement Plan
7. Feeling of belonging to an elite organization
8. Stability of a Navy career
9. Find duty at sea rewarding

## *QUESTION 4*

### *Demographic information*

A. Years of service (to the nearest month)

answer: \_\_\_\_\_.

B. Commissioning source (circle one):

- 1. Naval Academy    2. ROTC (regular)    3. ROTC (contract)
- 4. AOCS              5. AVROC              6. Other

C. Type of aircraft you are presently assigned to fly:

answer: \_\_\_\_\_.

D. Marital Status (circle one):

- 1. Married    2. Not married

E. Number of dependents: \_\_\_\_\_.

F. Number of deployments you have made while on active duty that were greater than three months in duration.

answer: \_\_\_\_\_.

G. Your current rank \_\_\_\_\_.

H. What is your ethnic identity? (circle one)

- 1. Black    2. Hispanic    3. Caucasian    4. Oriental    5. Other

I. Do you have prior enlisted service? (circle one)

- 1. Yes    2. No

J. What impact does the rate at which airlines are hiring have upon your decision to remain on active duty? (circle one)

- 1. Has impact
- 2. Has no impact

K. If married, does your spouse work fulltime outside the home? (circle one)

1. Yes    2. No

L. If you have children, are any of school-age? (circle one)

1. Yes    2. No

M. Aviation designator (circle one)

1. Pilot    2. NFO

N. Are you physically qualified *in all respects* to fly for a licensed air carrier (circle one)

1. Yes    2. No

#### *QUESTION 5*

If you were to leave the service *now* and take a civilian job, how do you think that job would compare with your present military job in regard to the following work conditions?

	About the same				
Civilian job would be a lot better	Civilian job would be slightly better	Civilian civilian and military job	Civilian job would be slightly worse	Civilian job would be a lot worse	
1. The immediate supervisors	1	2	3	4	5
2. Having a say in what happens to me	1	2	3	4	5
3. The chance for interesting work	1	2	3	4	5
4. The work schedule and hours of work	1	2	3	4	5
5. The job security	1	2	3	4	5
6. Location of the job	1	2	3	4	5

## APPENDIX B

### GEOGRAPHIC DISTRIBUTION OF TACTICAL PILOTS

FREQUENCY DISTRIBUTIONS OF NAVY TACTICAL PILOTS BY AQD  
AND STATE AS OF 8606  
TABLE OF STATE BY AQD

FREQUENCY PERCENT ROW PCT COL PCT	A-4	A-7	F-4	F-14	TOTAL
0	0 0.00 0.00 0.00	1 0.06 100.00 0.11	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.06 0.00 0.00
AL	0 0.00 0.00 0.00	2 0.12 66.67 0.23	0 0.00 0.00 0.00	1 0.06 33.33 0.16	3 0.17 0.00 0.00
CA	9 0.52 1.49 9.68	292 16.97 48.42 33.56	44 2.56 7.30 30.14	258 14.99 42.79 42.16	603 35.04 0.00 0.00
CO	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.06 100.00 0.16	1 0.06 0.00 0.00
DC	16 0.93 11.51 17.20	82 4.76 58.99 9.43	21 1.22 15.11 14.38	20 1.16 14.39 3.27	139 8.08 0.00 0.00
FL	15 0.87 3.99 16.13	319 18.54 84.84 36.67	10 0.58 2.66 6.85	32 1.86 8.51 5.23	376 21.85 0.00 0.00
GA	0 0.00 0.00 0.00	1 0.06 100.00 0.11	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.06 0.00 0.00
GQ	1 0.06 25.00 1.08	3 0.17 75.00 0.34	0 0.00 0.00 0.00	0 0.00 0.00 0.00	4 0.23 0.00 0.00
HI	10 0.58 30.30 10.75	9 0.52 27.27 1.03	9 0.52 27.27 6.16	5 0.29 15.15 0.82	33 1.92 0.00 0.00
IL	0 0.00 0.00 0.00	1 0.06 50.00 0.11	1 0.06 50.00 0.68	0 0.00 0.00 0.00	2 0.12 0.00 0.00
TOTAL	93 5.40	870 50.55	146 8.48	612 35.56	1721 100.00

FREQUENCY DISTRIBUTIONS OF NAVY TACTICAL PILOTS BY AQD  
 AND STATE AS OF 8606  
 TABLE OF STATE BY AQD

STATE AQD

FREQUENCY

PERCENT

ROW PCT

COL PCT

	A-4	A-7	F-4	F-14	TOTAL
MD	3 0.17 8.82 3.23	14 0.81 41.18 1.61	4 0.23 11.76 2.74	13 0.76 38.24 2.12	34 1.98
MA	0 0.00 0.00 0.00	1 0.06 100.00 0.11	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.06
MN	1 0.06 100.00 1.08	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.06
MS	4 0.23 18.18 4.30	14 0.81 63.64 1.61	1 0.06 4.55 0.68	3 0.17 13.64 0.49	22 1.28
MO	3 0.17 60.00 3.23	1 0.06 20.00 0.11	0 0.00 0.00 0.00	1 0.06 20.00 0.16	5 0.29
NE	0 0.00 0.00 0.00	1 0.06 100.00 0.11	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.06
NV	0 0.00 0.00 0.00	7 0.41 50.00 0.80	0 0.00 0.00 0.00	7 0.41 50.00 1.14	14 0.81
NH	1 0.06 100.00 1.08	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.06
NJ	0 0.00 0.00 0.00	1 0.06 33.33 0.11	1 0.06 33.33 0.68	1 0.06 33.33 0.16	3 0.17
NM	0 0.00 0.00 0.00	10 0.58 90.91 1.15	1 0.06 9.09 0.68	0 0.00 0.00 0.00	11 0.64
TOTAL	93 5.40	870 50.55	146 8.48	612 35.56	1721 100.00

## FREQUENCY DISTRIBUTIONS OF NAVY TACTICAL PILOTS BY AQD

AND STATE AS OF 8606

## TABLE OF STATE BY AQD

STATE AQD

	FREQUENCY	PERCENT	ROW PCT	COL PCT	A-4	A-7	F-4	F-14	TOTAL
NY	1 0.06 33.33 1.08	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	2 0.12 66.67 0.33	3 0.17			
OH	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.06 100.00 0.16	1 0.06			
PA	1 0.06 50.00 1.08	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 50.00 0.16	1 0.06 50.00 0.16	2 0.12			
RQ	6 0.35 54.55 6.45	3 0.17 27.27 0.34	1 0.06 9.09 0.68	1 0.06 9.09 0.16	1 0.06 9.09 0.16	11 0.64			
RI	1 0.06 4.17 1.08	13 0.76 54.17 1.49	1 0.06 4.17 0.68	9 0.52 37.50 1.47	9 0.52 37.50 1.47	24 1.39			
SC	1 0.06 14.29 1.08	4 0.23 57.14 0.46	2 0.12 28.57 1.37	0 0.00 0.00 0.00	0 0.00 0.00 0.00	7 0.41			
TN	4 0.23 66.67 4.30	1 0.06 16.67 0.11	0 0.00 0.00 0.00	1 0.06 16.67 0.16	1 0.06 16.67 0.16	6 0.35			
TX	7 0.41 8.97 7.53	40 2.32 51.28 4.60	11 0.64 14.10 7.53	20 1.16 25.64 3.27	20 1.16 25.64 3.27	78 4.53			
VA	8 0.46 2.43 8.60	49 2.85 14.89 5.63	37 2.15 11.25 25.34	235 13.65 71.43 38.40	235 13.65 71.43 38.40	329 19.12			
WA	1 0.06 25.00 1.08	1 0.06 25.00 0.11	2 0.12 50.00 1.37	0 0.00 0.00 0.00	0 0.00 0.00 0.00	4 0.23			
TOTAL	93 5.40	870 50.55	146 8.48	612 35.56		1721 100.00			

Source: Defense Manpower Data Center

## APPENDIX C

### SURVEY DATA LISTING

TITLE DETERMINANTS OF NAVY TACTICAL PILOT RETENTION;  
 DATA ONE;

INPUT	RETN 1	
	PAY 3	
	CMND 5	
	FLY 7	
	BEN 9	
	RETR 11	
	ELI 13	
	STA 15	
	YOS 17	
	NAVCAD 19	
	ROTCR 21	
	AVROC 23	
	AOCS 25	
	OTHER 27	
	F18 29	
	A7 31	
	F14 33	
	A4 35	
	MARRD 37	
	DEPD 39	
	DEPY 41	
	LTJG 43	
	LET 45	
	LCDR 47	
	CDR 49	
	CAPT 51	
	CAUC 53	
	AIRL 55	
	SPOUSE 57	
	TAST 59-62	
	CAREER 64 ;	
LABEL	RETN='WOULD STAY IN PAST MSR UNDER NEW LAW'	;
LABEL	PAY='PAY IS MOST IMPORTANT REASON TO STAY'	;
LABEL	CMND='OPPORTUNITY FOR COMMAND IS WHY I STAY'	;
LABEL	FLY='OPPORTUNITY TO FLY JETS IS WHY I STAY'	;
LABEL	RETR='RETIREMENT PAY IS WHY I STAY IN'	;
LABEL	ELI='BEING IN AN ELITE GROUP IS WHY I STAY'	;
LABEL	STA='JOB STABILITY IS WHY I STAY'	;
LABEL	YOS='YEARS OF SERVICE'	;
LABEL	NAVCAD='COMMISSIONING SOURCE: NAVAL ACADEMY'	;
LABEL	ROTCR='COMMISSIONING SOURCE: ROTC (REGULAR)'	;
LABEL	AVROC='COMMISSIONING SOURCE: AVIATION ROC'	;
LABEL	AOCS='COMMISSIONING SOURCE: AVIATION OCS'	;
LABEL	MARRD='MARITAL STATUS'	;
LABEL	DEPD='NUMBER OF DEPENDENTS'	;
LABEL	DEPY='NUMBER OF REGULAR DEPLOYMENTS'	;
LABEL	LTJG='RANK: LTJG'	;
LABEL	LET='RANK: LT'	;
LABEL	LCDR='RANK: LCDR'	;
LABEL	CDR='RANK: COMMANDER'	;
LABEL	CAPT='RANK: CAPTAIN'	;
LABEL	AIRL='AIRLINE HIRING INFLUENCES MY DECISION'	;
LABEL	SPOUSE='MY SPOUSE WORKS OUTSIDE OUR HOME'	;
LABEL	TAST=' TASTE FOR MILITARY SERVICE'	;
LABEL	COMSOU='COMMISSIONING SOURCE' /	;
RESPDNT	= 1 ;	
	AIRCRFT=F18*2**3+A7*2**2+F14*2+A4 ;	
	SOURCE=NAVCAD*2**3+ROTCR*2**2+AVROC*2+AOCS ;	
	RANK=LET*2**3+LCDR*2**2+CDR*2+CAPT ;	

```
IF TAST>0 & TAST<3 THEN TASTGRP=1;  
ELSE IF TAST=3 THEN TASTGRP=2;  
ELSE IF TAST>3 THEN TASTGRP=3;  
CARDS:
```

0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	2.50	1			
0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	1	1	0	1	0	2.83	0				
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1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1	1	0	0	1	0	0	2.83	1	
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1	0	0	0	0	1	0	0	0	0	1	0	0	0	1	1	1	0	0	1	0	1	0	1	3.33	1





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**APPENDIX D**  
**ESTIMATED CONTINUATION RATES**

YOS	Loss Rate	Continuation Rate	Survival Rate
2	.0001	.9999	.9999
3	.0132	.9868	.9867
4	.0047	.9953	.9820
5	.0050	.9950	.9771
6	.0795	.9205	.8994
7	.4451	.5549	.4990
8	.4795	.5205	.2590
9	.1942	.8058	.2087
10	.1650	.8350	.1742
11	.1086	.8914	.1553
12	.1092	.8908	.1383

## APPENDIX E

### DESCRIPTIVE STATISTICS

#### 1. RESPONDENT BY COMMISSIONING SOURCE

TABLE OF SOURCE BY RESPDNT

	FREQUENCY	PERCENT	ROW PCT	COL PCT	1	TOTAL
OTHER					16	16
					5.30	5.30
					100.00	
					5.30	
AOCS					106	106
					35.10	35.10
					100.00	
					35.10	
AVROC					50	50
					16.56	16.56
					100.00	
					16.56	
ROTC					59	59
					19.54	19.54
					100.00	
					19.54	
NAVAL ACADEMY					71	71
					23.51	23.51
					100.00	
					23.51	
TOTAL	302				302	302
					100.00	100.00

## 2. RESPONDENT BY AIRCRAFT TYPE

TABLE OF AIRCRFT BY RESPDNT

AIRCRAFT            RESPDNT

	FREQUENCY	PERCENT	ROW PCT	COL PCT	1	TOTAL
A4					34	34
					11.26	11.26
					100.00	
					11.26	
F14					83	83
					27.48	27.48
					100.00	
					27.48	
A7					98	98
					32.45	32.45
					100.00	
					32.45	
F18					87	87
					28.81	28.81
					100.00	
					28.81	
TOTAL					302	302
					100.00	100.00

### 3. RESPONDENT BY RANK

TABLE OF RANK BY RESPDNT

	FREQUENCY	PERCENT	TOTAL
	ROW PCT	COL PCT	
LTJG	1		
	9	2.98	9
	100.00		2.98
	2.98		
CAPT		4	4
		1.32	1.32
		100.00	
		1.32	
CDR		24	24
		7.95	7.95
		100.00	
		7.95	
LCDR		81	81
		26.82	26.82
		100.00	
		26.82	
LT		184	184
		60.93	60.93
		100.00	
		60.93	
TOTAL		302	302
		100.00	100.00

## APPENDIX F

### THE TASTES FACTOR

#### 1. SUMMARY DATA

TASTGRP	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
FAVORS CIVILIAN	177	177	58.609	58.609
NEUTRAL	42	219	13.907	72.517
FAVORS MILITARY	83	302	27.483	100.000

#### 2. TASTES BY RANK

TASTGRP	RANK						TOTAL				
		FREQUENCY	PERCENT	ROW PCT	COL PCT	LTJG	CAPT	CDR	LCDR	LT	
FAVORS CIVILIAN						4	1	5	38	129	177
						1.32	0.33	1.66	12.58	42.72	58.61
						2.26	0.56	2.82	21.47	72.88	
						44.44	25.00	20.83	46.91	70.11	
NEUTRAL						0	0	6	14	22	42
						0.00	0.00	1.99	4.64	7.28	13.91
						0.00	0.00	14.29	33.33	52.38	
						0.00	0.00	25.00	17.28	11.96	
FAVORS MILITARY						5	3	13	29	33	83
						1.66	0.99	4.30	9.60	10.93	27.48
						6.02	3.61	15.66	34.94	39.76	
						55.56	75.00	54.17	35.80	17.93	
TOTAL						9	4	24	81	184	302
						2.98	1.32	7.95	26.82	60.93	100.00

### 3. TASTES BY AIRCRAFT

TASTGRP	AIRCRFT				
FREQUENCY	A4	F14	A7	F18	TOTAL
PERCENT					
ROW PCT					
COL PCT					
FAVORS CIVILIAN	16 5.30 9.04 47.06	44 14.57 24.86 53.01	56 18.54 31.64 57.14	61 20.20 34.46 70.11	177 58.61
NEUTRAL	8 2.65 19.05 23.53	17 5.63 40.48 20.48	10 3.31 23.81 10.20	7 2.32 16.67 8.05	42 13.91
FAVORS MILITARY	10 3.31 12.05 29.41	22 7.28 26.51 26.51	32 10.60 38.55 32.65	19 6.29 22.89 21.84	83 27.48
TOTAL	34 11.26	83 27.48	98 32.45	87 28.81	302 100.00

#### 4. TASTES BY SOURCE

TASTGRP	SOURCE						
FREQUENCY							
PERCENT							
ROW PCT							
COL PCT	OTHER	AOCS	AVROC	ROTC	NAVAL ACADEMY	AC	TOTAL
FAVORS CIVILIAN	10 3.31 5.65 62.50	63 20.86 35.59 59.43	32 10.60 18.08 64.00	27 8.94 15.25 45.76	45 14.90 25.42 63.38		177 58.61
NEUTRAL	1 0.33 2.38 6.25	13 4.30 30.95 12.26	5 1.66 11.90 10.00	21 6.95 50.00 35.59	2 0.66 4.76 2.82		42 13.91
FAVORS MILITARY	5 1.66 6.02 31.25	30 9.93 36.14 28.30	13 4.30 15.66 26.00	11 3.64 13.25 18.64	24 7.95 28.92 33.80		83 27.48
TOTAL	16 5.30	106 35.10	50 16.56	59 19.54	71 23.51		302 100.00

## 5. TASTES BY STATED RETENTION

TABLE OF TASTGRP BY RETN

FREQUENCY PERCENT ROW PCT COL PCT	LEAVE	STAY	TOTAL
FAVORS CIVILIAN	156 51.66 88.14 69.03	21 6.95 11.86 27.63	177 58.61
NEUTRAL	28 9.27 66.67 12.39	14 4.64 33.33 18.42	42 13.91
FAVORS MILITARY	42 13.91 50.60 18.58	41 13.58 49.40 53.95	83 27.48
TOTAL	226 74.83	76 25.17	302 100.00

## 6. TASTES BY SPOUSE EMPLOYMENT

TABLE OF TASTGRP BY SPOUSE

	FREQUENCY PERCENT ROW PCT COL PCT	NOT EMPL OYED	EMPLOYED	TOTAL
FAVORS CIVILIAN		120 39.74 67.80 54.30	57 18.87 32.20 70.37	177 58.61
NEUTRAL		30 9.93 71.43 13.57	12 3.97 28.57 14.81	42 13.91
FAVORS MILITARY		71 23.51 85.54 32.13	12 3.97 14.46 14.81	83 27.48
TOTAL		221 73.18	81 26.82	302 100.00

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